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MALTING PLANT POWER EQUIPMENT

Steam Power Installation, the Most Economic for Malting Plants

DURING THE HOT, DRY, thirst-producing summer days when indulging in cooling beverages, did you ever stop to think about the process of their production? Probably not, especially if you wanted just one cool drink of beer in a hurry, before catching the train for a hot and dusty trip. Malting of barley, preparatory to its final manufacture into beer, is usually accomplished in special malting plants, although, in some instances, the malting of the barley and brewing of beer are produced in the same establishment. The Manitowoc Malting Co. is one of the concerns which specializes only in the malting of grain and it may be of interest to know that it was the first to install the Saladin Prinz system of 8-day malting in the United States. Even after 10 yr. of successful operation it still is credited with a better economical production in malting than any other concern in the United States producing a similar grade of malt.

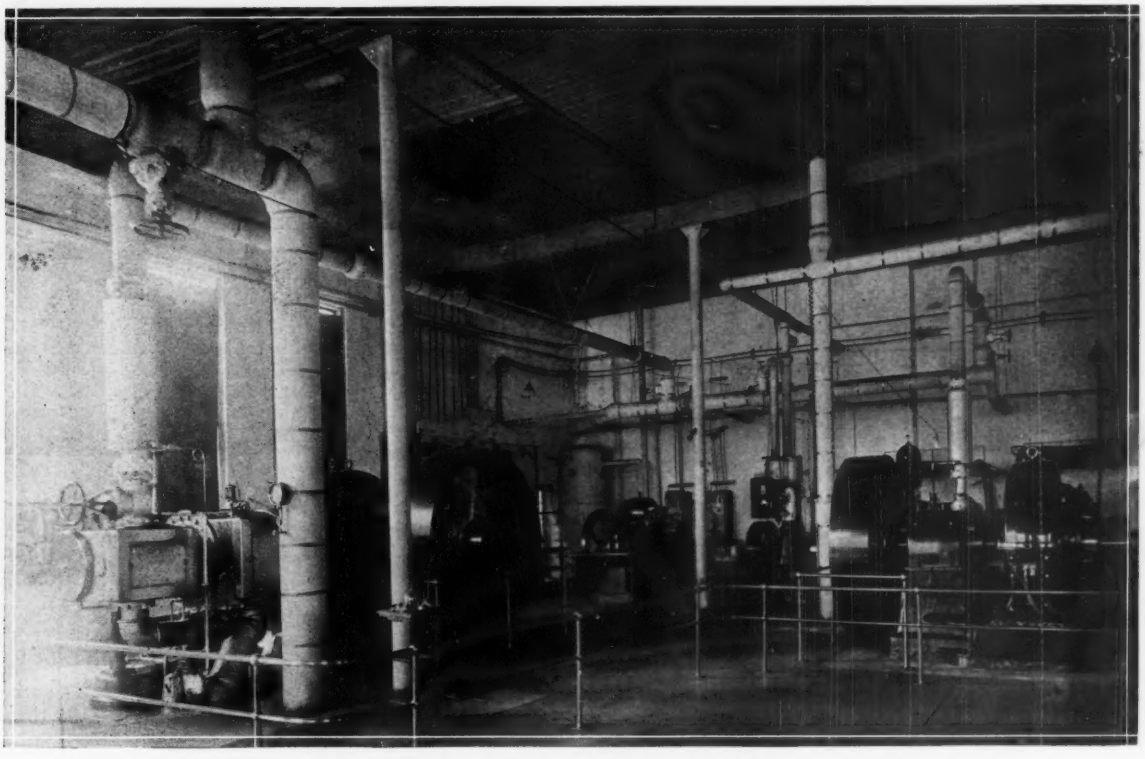


FIG. 1. GENERAL VIEW OF ENGINE ROOM

Heat, and especially steam heat, is one of the important factors in the malting process and should be of particular interest to the isolated plant engineer. The above mentioned plant is advantageously located

at a picturesque spot on the Manitowoc River which flows into Lake Michigan. It is on a spur track, easily accessible to 2 large railroad trunk lines and within a short distance of a large coal dock.

Due to the rapid growth of the plant, the arrangement of the engine and boiler room is entirely changed from its original layout. While a back to back system of piping was at first possible, the engine and boiler rooms are now placed on a compromise between back to back and end to end, as seen in Fig. 5; this being necessary to provide for sufficient boiler space and room for future expansion; the original stack, as will be noticed, occupying a position back of the engine room, thus preventing a convenient layout for future expansion. The original boiler room has been turned into a machine shop, which is described further on.

The usual setting for horizontal return-tubular boilers is resorted to with the difference, however, that a special arrangement provides for effectual smoke prevention. This is shown in Fig. 6. The usual combustion chamber back of the fire arch is closed off by a fire brick wall 18 in. back of the arch. This wall contains 2 openings which lead into 2 arched fire brick passages, 10 in. radius by 3 ft. high. These flues lead into the rear combustion chamber, from which the gases pass through the fire tubes into the uptake and breeching, in usual manner.

Complete cost of the extra setting amounted to $75, but it is giving perfect satisfaction, not only in smokeless combustion, but also in that it practically disposes of soot and fine ash ordinarily found in the tubes, which in this case gathers in the 2 passages where it can be easily removed. The efficiency of the boiler is but little impaired, even prior to cleaning the passages, compared to what would ordinarily result in uncleaned tubes filled with soot and fine ash.

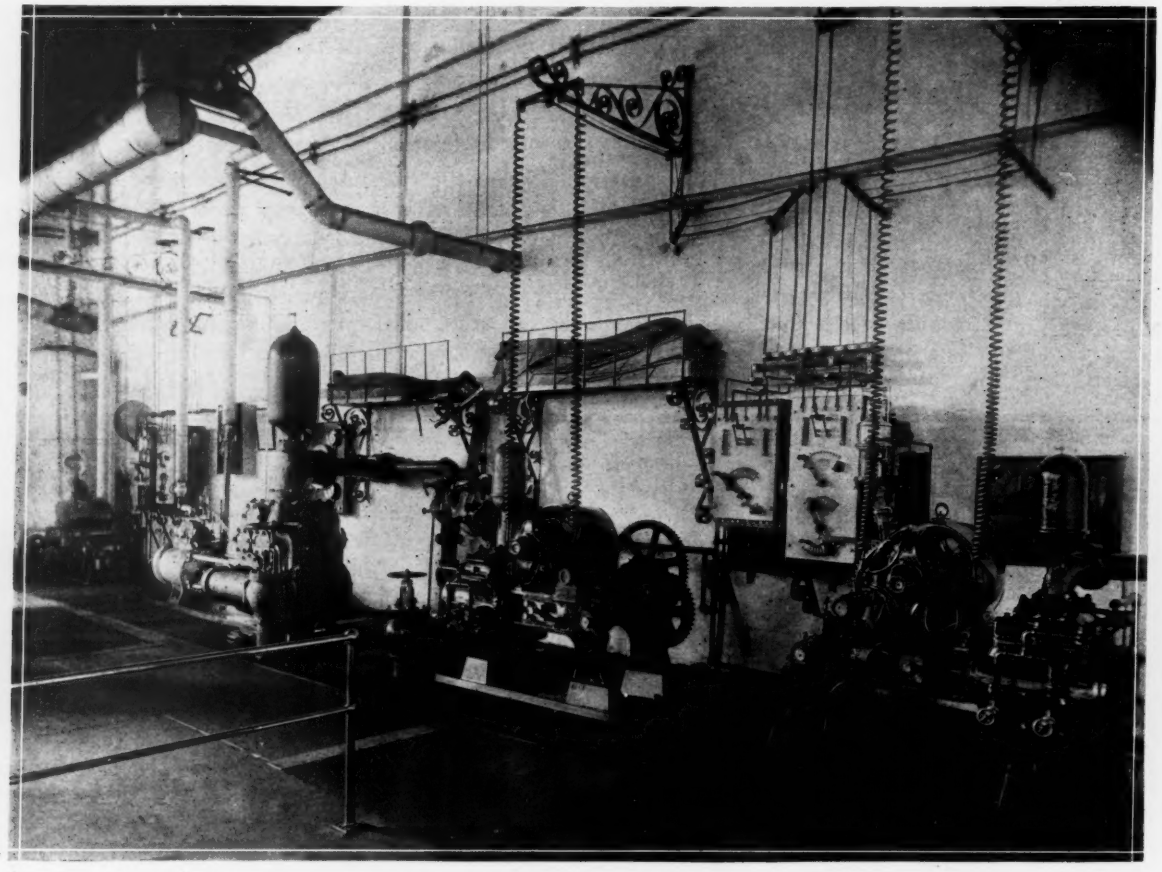


FIG. 2. HOME-MADE PUMPING UNITS

Boiler Room

EQUIPMENT in the boiler room consists of 2 sets of 2 185-hp. horizontal, return fire-tube boilers, 78 in. in diameter by 20 ft. long, containing 84 4-in. tubes, a grate area of 32 sq. ft. and provided with a steam dome, Crossby spring loaded safety valve, a water column and gage glass with an "S. C." water level regulator attachment and the usual blowoff cock and accessories.

Herringbone, stationary grates, with ⅜-in. bars and ¼-in. air openings, have replaced the original shaking grates, as the change proved more economical in saving of coal and especially so in cost of repairs.

Boiler fuel used is Pocahontas screenings, fired by the coking method; a bed of from 18 to 24 in. being maintained on the grates at all times. The draft obtained in furnace averages 4 in. of water.

The boilers are all connected to a straight-way 3/16-in. steel breeching 48 in. in diameter, which connects at one end with the 5-ft. diameter unlined brick stack 130 ft. high. The temperature of the flue gases in the uptake averages 500 deg. F.

Hand firing of the boilers is resorted to in summer and during warm weather when the required heating load is not heavy. During the cold weather period, Erie Foundry Co. stokers are used. These are of the underfeed type provided with steam jets to create necessary forced draft. It may be of interest to know that previous to the prolonged cold spell during the winter of 1912, hand-firing had been applied entirely, but it was found necessary to install stokers to increase the boiler power. These stokers were installed ready for operation, as shown in Fig. 3, in 2 days' time, the plant not being shut down any during the work of installation.

From the railroad cars, which pass directly in front of the boiler room, coal can be shoveled direct into the 100-ton storage bin, which is in front of the boilers and rests on the firing floor. Due to the lack of car space during a shipment of malt, or when the space directly in front of the bin is filled with cars, facility for unloading of coal is provided for by a receiving hopper, placed 50 ft. from the boiler room. The coal, after being dumped into this hopper, passes through adjustable sliding gates in the bottom which regulate the amount passing through onto a belt conveyor placed underneath which is entirely inclosed for weather protection and leads directly to the top of the storage bin where it is dumped by means of an adjustable tripper, thus providing for uniform filling of the bin or otherwise as desired. The bin is divided into sections so that various grades of coal can be used at any one time or so that a weighed amount for a test or other purposes can be stored conveniently. The coal and ash can be conveniently weighed on a platscale placed in the firing lane as shown in Fig. 3. The ash is removed in wheelbarrows on the firing floor.

Continuous operation of the plant 24 hr. a day during the entire year, requires a yearly consumption of coal amounting to 5000 tons. The necessary labor is furnished by 3 firemen in 10-hr. shifts during the 24 hr., which provides for the overlapping of shifts, thus facilitating and insuring sufficient labor for cleaning and repairs.

The boilers are fed by a single feed pipe line passing over the fronts and connected at one end to a 12 by 7 by 10-in. "American" duplex steam pump. A Smith-Vaile 7 by 4 by 10-in. duplex pump is used in case of emergency.

Boiler feed-water supply is from 2 sources, one being the condensation returns from the heating system, and the other is from the river. The return condensation is connected to a 5 by 5 by 5-ft. 3/8-in. sheet-iron tank which acts not only as a storage, but also as a feed-water heater, the temperature maintained averaging 200 deg. The steam not condensed in the various heater coils about the plant, returns, with the condensation, to the heater and there either condenses or escapes through the atmospheric vent pipe.

The water level maintained in the heater is governed by a float regulator. Should the condensation be insufficient at any time and the water level drop below normal, the float opens a steam valve which causes a 7 by 4 by 10-in. Smith-Vaile duplex steam pump to operate, taking its suction from the river water and discharging directly into heater.

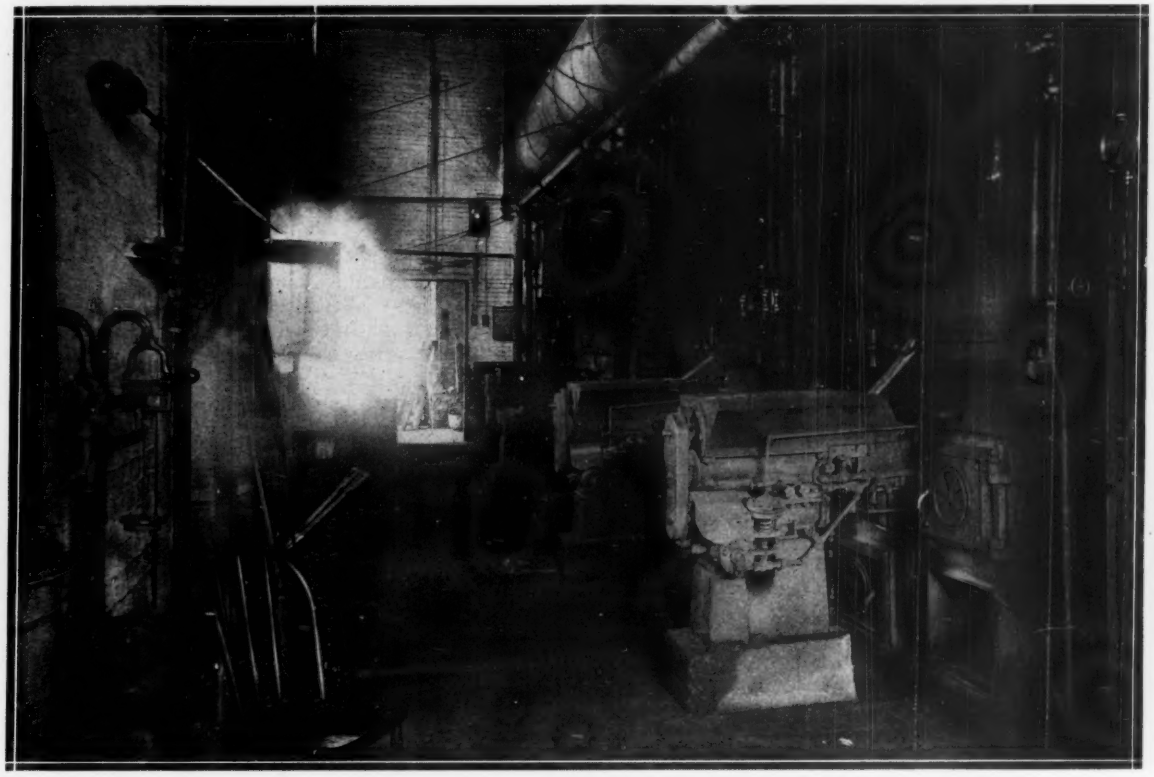


FIG. 3. VIEW OF BOILER ROOM

Passing over the tops of the boilers is a single 8-in. steam header, suitably provided with drips and oil separators, which furnishes the steam for the generating units and pump in engine room.

Engine Room Equipment

THE main power unit is a 150-kw., 220-v., 225-r.p.m. Milwaukee Electric Co. d.c. generator, direct connected to a Chuse tandem compound, center crank engine. The exhaust, as shown in Fig. 1, passes through an

FIG. 4. HEATER COILS AND DRY KILNS IN MALT HOUSE

8-in. pipe to the heating coils in the malt plant; a tee at the upper end of the exhaust pipe provides for a connection to a back pressure valve and a roof outlet.

An additional 100-kw., 220-v., 265-r.p.m. unit of above type and make of generator and engine is also used, and its exhaust is likewise equipped with back pressure valve and roof outlet, and used for heating coils in the malt plant.

A smaller unit, of 25-kw., 110-v., 325-r.p.m. Milwaukee Electric Co. d.c. generator direct connected to a Bayley simple upright engine, furnishes the lighting power for the entire plant.

Cooling water for the sprays in the air attemperating room is furnished by a 14 by 14 by 20 Karnak simplex steam pump. The suction is connected with a reservoir which is supplied by a 12 and 8-in. artesian well. The exhausts from the 25-kw. unit and the Karnak pump are connected to the exhaust line of the 100-kw. unit.

Should the artesian wells at any time fail to maintain the usual water level in reservoir, an installed compressed air pumping system can be resorted to in raising the water. The air for this purpose is supplied by a 12 by 14-in. Laidlaw-Dunn-Gordon simple air compressor driven by a 20-hp. Milwaukee Electric Co. d.c. motor. The main duty of the air compressor is to supply the necessary air for aerating the seeps in the process of malting, the air being stored in a 56-cu. ft. capacity tank in which a 60-lb. pressure is carried.

Quite a little of the machinery is made or repaired in the machine shop connected with the plant. A 7 by 10-in., an 8 by 10-in., and a 4 by 6-in. Smith-Vaile water cylinder have been suitably attached to home-made center crank frames and geared to motors mounted on the same frames. These pumps, shown in Fig. 2, are each governed by Mason pressure regulators in conjunction with Cuttler-Hammer motor speed regulators. The 4 by 6-in. pump, driven by a 7½-hp. Milwaukee Electric Co. d.c. motor, is used to supply water for washing purposes in the malt house. The 7 by 10-in. and 8 by 10-in. pumps, driven by 15-hp. motors, are used for emergency and fire purposes.

The switchboard, consisting of 4 white marble panels, is equipped with Weston volt and ammeters, I. T. E. circuit breaker and switches and Western Electric Co. lightning arresters.

Since the bearing boxes in a malting plant are usually situated quite a distance from the engine room, due to the extensive grain elevators and conveying machinery required, a hot box detection system has been installed with a suitable indicator box and an alarm bell in the engine room. It is the duty of one man to inspect and oil all machinery. Should any of the bearings on the system run hot, an electrical thermostat gives the alarm in the engine room and the indicator shows the position or number of bearing.

The plant is also equipped with an electric fire alarm system. On each floor level of the malting plant an easily accessible switch is placed, which can be operated to ring a large gong in the engine room.

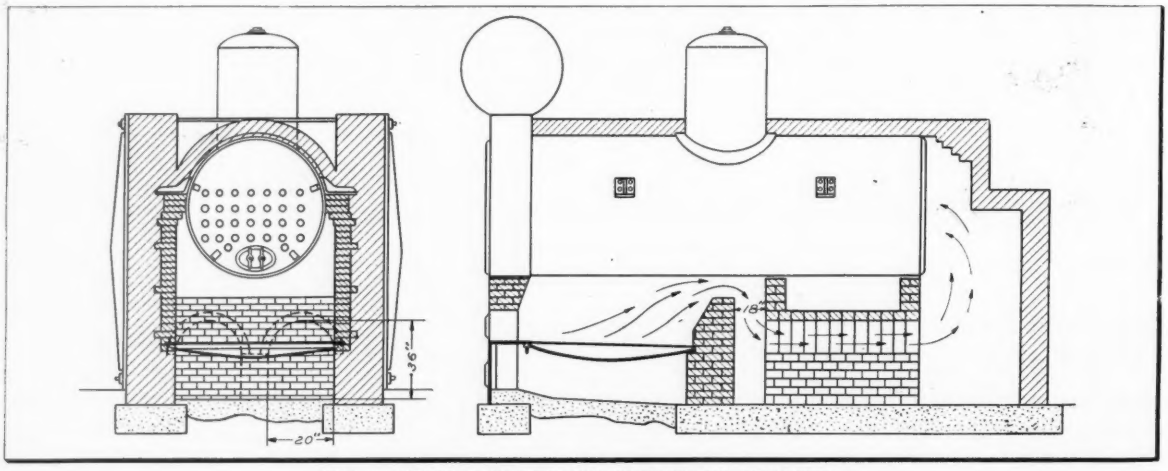


FIG. 6. SPECIAL SMOKELESS COMBUSTION CHAMBER

This can be heard all over the plant and is intended to call the workmen for fire duty. Suitable fire protection, such as outlets and hose, are placed on each floor.

Machine Shop

ONE of the interesting features of the power plant is the machine shop and tools available for repairs or new equipment of machinery. This is equipped with one 24-in. swing by 12-ft. bed, and one 12-in. swing by 6-ft. bed engine lathe; one power drill-press; one 26-in. by 26-in. by 6-ft. planer; one Curtis pipe-threading machine of capacity up to 6-in. pipe; one power driven hack-saw; one 20-in. shaper; one emery grinder; one complete forge outfit. Besides all the necessary tools for the machines mentioned above, the shop is also equipped with electric hand drills and cylinder boring rigs. A 5-hp., 110-v. d.c. motor is used as driving power and can be run either by current from the engine room or connected to outside power, should a shutdown occur in the plant.

The feasibility of the machine shop is well illustrated in the various conveniences and contrivances found about the plant and the quick repairs possible at any time of the day or night. Examples of this might be mentioned, such as the rapid installation of the stokers at a time of urgent need. The belt conveyor for the coal is another instance of the home-made appliance. The 3 motor-driven pumps and the motor-driven air compressor in engine room are all examples of the service to which a machine shop might be used. In the malting plant, repairs are constantly being made cheaply and readily. One of the recent labor-saving devices of particular interest is a conveyor feeding device. This consists of a cross-shaped feeder being a shaft with sheet-iron wings fastened to it. This shaft is placed in a trough which feeds a spiral conveyor. Any amount of malt may be dropped into this trough at one time without danger of choking the conveyor, as the feeding device permits only a certain amount to pass during each revolution, much the same as a revolving door in a building. Previous to the installation of this device, 2 laborers were constantly required to feed the conveyor. This labor and loss of time is now cheaply and more efficiently managed with the mechanical feeder.

The machine shop has even afforded means for the investigation and experimental work on various power devices and gasoline engine carburetors. It has proved to be not merely a source of economy in quick and inexpensive repairs of the plant equipment, but it also furnishes an incentive for the proposal of new ideas, in that, if the ideas have any value, they are almost certain to be applied and can be made at once or at leisure, as the circumstances of the case require.

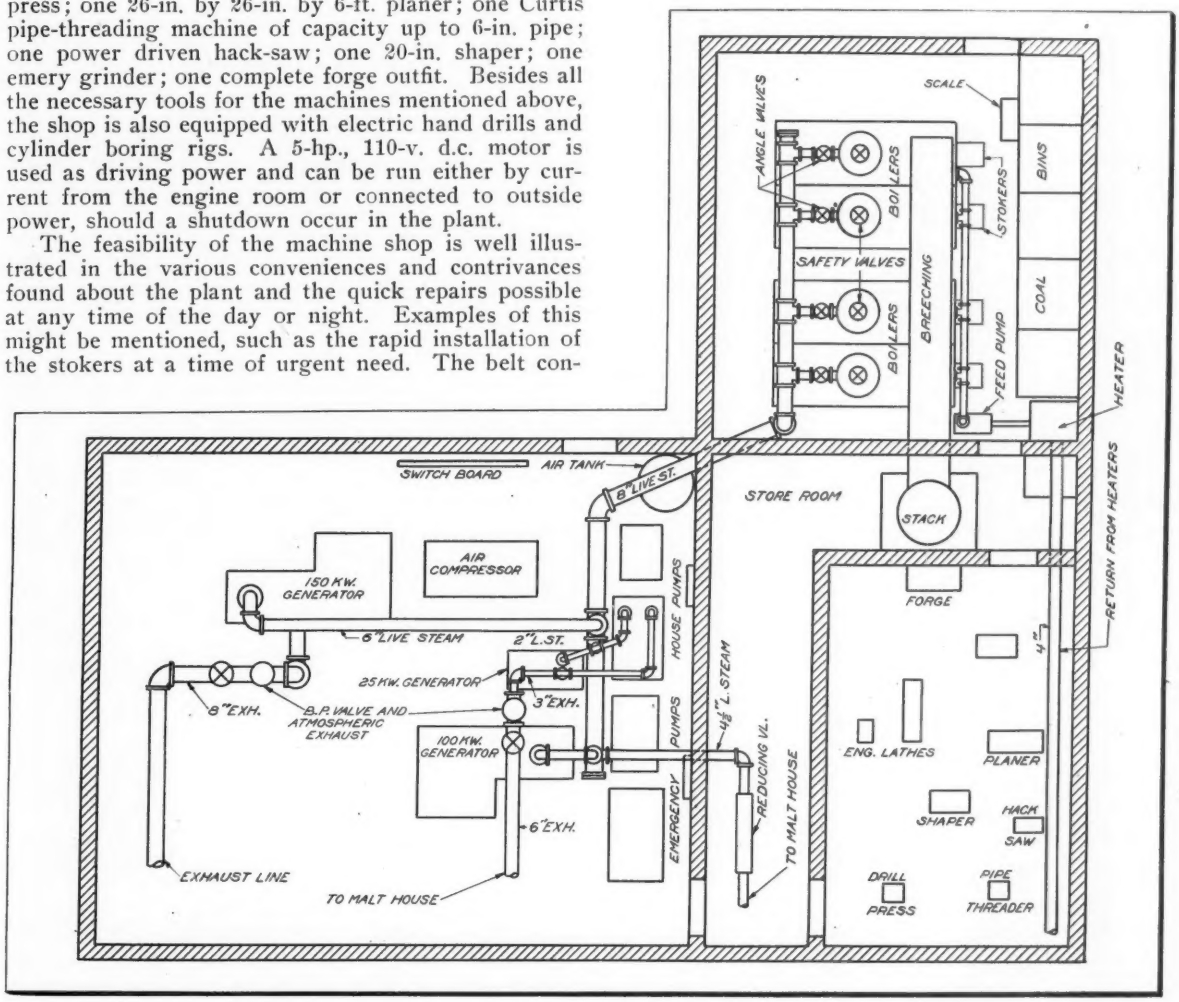


FIG. 5. LAYOUT OF POWER PLANT

Recovering Latent Heat of Steam

CONSIDERABLE heat is required in the germination process of the barley and later on in the drying of the completed malt product. This heat is furnished in 2 ways and can be best understood by reference to Fig. 4. The exhaust steam from the engines and steam auxiliaries is passed through heating coils as shown in upper right-hand corner. This heat is never sufficient to do the required amount of work and is the main argument for the economical use of steam in malting plants, as all latent heat of the steam can

be used and in severe weather even live steam suitably reduced must be supplied to the coils. To govern the constancy in temperature and current of the heat required, anthracite fires are kept burning in the hot air shafts. A Bristol recording thermometer is used to keep a constant record of the resulting temperature. Should the temperature at any time vary from the required degree, suitable increase or decrease can be provided for in the proper manipulation of the draft dampers and anthracite fire.

Power requirements in the malting plant, besides those already mentioned, are found mainly in the 30-hp. drive of the grain elevators and conveyors; the 60-hp. drives for Garden City fans and the various churning machines in the germinating room.

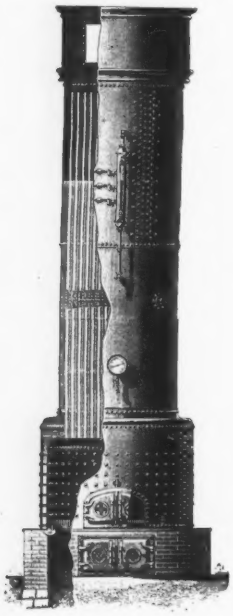
Niels Rahr, chief engineer of the power plant, is to be praised for its efficient and careful operation, and acknowledgment is due him for the many courtesies extended and for information so willingly given.

THE MANNING BOILER

Details of Its Design and the Reasons for Them

By JOHN A. LEVY

INTERNALLY fired boilers may be horizontal or vertical. Of vertical fire tube boilers, the Manning boiler is one of the most interesting, and that manufactured by the Bigelow Co. of New Haven, Conn., has some special improvements. Vertical boilers were originally of small capacity and designed for low pressures, but as higher pressures were demanded and larger units were required, it was soon seen that the limited grate surface was a barrier to increasing the heating surface; that is, if the proper ratio of heating surface to grate surface for the best economy was to be maintained, the grate surface could be increased



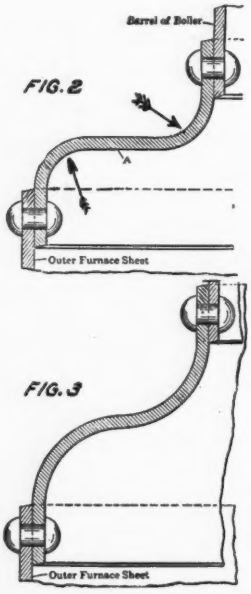
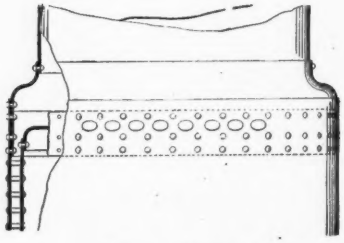


FIG. 1. SECTION OF THE BIGELOW MANNING BOILER
FIG. 2. FIRST FORM OF OGEE RING
FIG. 3. IMPROVED SHAPE OF OGEE

only by increasing the diameter of the boiler, which for a given thickness of plate would reduce the safe working pressure. We can increase the thickness of the plate, and since the outer shell of the boiler is not in contact with the fire the shell plates can be made of any thickness to withstand the pressure, consequently this is just what was done. Then difficulties began to present themselves; the heavier plates were more difficult to roll, the possibility of cold sheets, laminations and imperfections in the plate was greatly increased; but what was still more felt was the increased cost.

Thickness and Expansion

WITH a view to getting around these troubles the Manning boiler was designed by Captain Charles Manning, the primary object being to get an increased grate area, without increasing the diameter of the boiler. To accomplish this end a furnace of larger diameter than the boiler was connected to the boiler barrel by a flanged ring, which is now commonly called the ogee ring, which also acts as an expansion joint, providing for the expansion and contraction of the tubes. In other types of vertical fire-tube boilers this expansion and contraction must be taken up by the small portion of the crown sheet, between the outer edge and the tubes which must result in a bending action at this point.



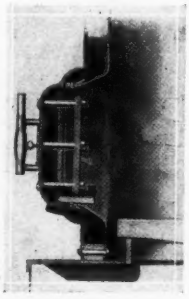


FIG. 4. FORM OF EXTENDED OGEE RING
FIG. 5. DETAIL OF FIREDOOR CONSTRUCTION

The original form of the ogee ring is shown in Fig. 2, presenting considerable flat surface, upon which the pressure acted, also the expansion and contraction set up a bending action at the points indicated by the arrows, thus defeating its purpose as an expansion joint. Figure 3 shows the improved form of ogee ring having the natural expansion curve.

In the earlier Manning boilers the outer furnace sheet was the same thickness as the ogee ring, while the inner furnace sheet was made thin in order better to transmit the heat of the furnace to the water.

This thick outer furnace sheet imposed severe strains on the stay bolts, causing them to break. A thin outer furnace sheet was substituted for the thicker one, because since the water leg was securely staybolted, it was safe to do so, as the area against which the pressure acts in tending to force the 2 cylinders apart is the cross-sectional area of the space in the

water leg, as shown at the left, Fig. 1. But the thin outer furnace sheet presented a new obstacle, since the space between the upper staybolts and the ogee ring presented an unstayed surface, in a cylinder, whose safe working pressure depended upon the diameter, and this thin sheet would not meet the conditions. To make this safe, the ogee ring was extended down to the upper stay bolts and securely riveted to the outer furnace sheet. While the pressure tends to set this extended portion out against the outer furnace sheet it also calls for good calking. Fig. 4 illustrates clearly this construction of this part of the boiler.

Originally the ogee ring was located down close to the crown sheet and hand holes, for access to the crown sheet were located in the body of the boiler. In the improved construction shown in Fig. 4 the ogee ring is raised and handholes placed in the outer furnace sheet directly on a line with the crown sheet. These handholes are located opposite adjacent aisles between the tubes, which makes it possible to clean every inch of the crown sheet, thus removing what many engineers considered a cause for prejudice against this type of boiler. This system of handholes is known as the Bigelow cleaning device, and is original with that company.

Feed Location

REFERRING to Fig. 1, we see that the feedpipe enters the body of the boiler instead of the water leg. There are 4 reasons for this: First, if the feedpipe entered the water leg, the comparatively cold water would be discharged directly against the hot furnace sheet; second, any air mixed with the water would have a chance to attack the staybolts and plates in the water leg; third, since the water leg forms a natural settling chamber, the entering feed water would keep the sediment in continuous agitation; fourth, as a consequence of the mud and sediment being kept agitated it would work up onto the crown sheet. Again, while it may not be considered a reason for discharging the feed water in the body of the boiler, it seems at least worthy of consideration, that the feed water, entering where it does, has a tendency to keep the central column of the contents of sufficient density to prevent being lifted off the crown sheet when the boiler is being forced hard. We are led to see the weight of this argument by the fact that the circulation in this boiler is up the center and down the side.

An article appearing in a prominent power plant journal, shortly after the failure of one of the Manning boilers in the Amoskeag Mills at Manchester, N. H., states the cause of the explosion to be, according to Captain Manning, that the fireman had the feed valve shut, in order to aid in regaining a slight drop in the steam pressure, and the boiler being forced to its utmost, the central column over the crown sheet became light enough to be lifted off the crown sheet, thus allowing the crown sheet to become overheated, and the 190 lb. pressure forced it downward, pulling the tube ends through the sheet.

Failure of this type of boiler is a rare occurrence. In order to settle controversies as to what was really the weakest part of the Manning boiler, tests have been made, accounts of which have previously been printed, with the result that the boiler failed by the collapsing of the tubes, but even this did not occur until the pressure had been raised, on one occasion to over 900 lb. per sq. in.

In Fig. 5 is illustrated the furnace door opening, which is constructed by first cutting elliptical openings in the furnace sheets, after which the plate around the openings is heated and the sheets flanged outward by a hydraulic flanging machine, until the edges of the sheets meet, and are then riveted together. With this form of construction the rivets are not in direct contact with the fire and the possibility of leaky rivets is avoided.

Manning Advantages

SOME advantages of the Manning boiler are, total absence of brick setting, making the cost of installation low; as the boiler is internally fired, there are no air leaks into the furnace; a great saving in floor space, which in some localities is very important; and the boiler will furnish superheated steam.

The amount of superheat varies with the size of boiler, and the water level, but a boiler of 500 hp. capacity with tubes 20 ft. long and the water carried at 7 ft. below the upper tube sheet will furnish steam superheated 50 deg., when the boiler is worked at its rated capacity. As this superheat is obtained without any additional cost, and without extra apparatus, it has a direct bearing on the over-all efficiency and economy of the boiler.

Frequently the Manning boiler is equipped with mechanical stokers, in which case the boiler is supported by lugs riveted to the side of the boiler, these lugs resting on steel frame work, which can be erected to bring the boiler to any desired height. When hand fired the boiler rests on a brick base which also forms the ash pit or on a metal base, furnished by the builders of the boiler. Handholes are provided around the lower part of the water leg, for cleaning out purposes. The top, which is set loosely on the boiler proper, is provided with an opening to which is attached the smoke flue, and the top can be moved around so as to bring the opening to any convenient position.

IN CONNECTION with the recent contract for an individual plant for the Chicago Postoffice, some peculiar figures are given out. The rate formerly paid to the Commonwealth-Edison Co. was 3 cents a kilowatt-hour, amounting to about $25,000 a year. When the installation became probable, a rate of 1.5 cents was offered, whereas private companies using more current than the government were paying 2 cents. It was estimated that the new plant would save some $10,000 a year, making the cost about $15,000, whereas the new rate for Edison current would make the cost $12,500. Exact conditions of the Edison offer are not known, however, and other features than cost may, probably, have been the determining factors.

Based on this and other rates which seem unfairly discriminating to the Council Committee, recommendation has been made for revision in the rate schedule in one of the following ways:

1. Lighting rate 10 cents a kw.-hr. for first hour's daily use of maximum demand, 5 cents for second and 3 cents for all over 2, thus placing retail light and power on the same basis.

2. Reduction in the primary rate for both light and power below a 10-cent maximum.

3. Reduction in the secondary rate for both light and power below a 5-cent maximum.

4. Reduction in the hours of daily use of maximum demand before the secondary rate applies.

Also it is recommended that a number of special discounts now granted to several classes of customers be eliminated.

SUPERHEATED STEAM IN THE POWER STATION*

By Arthur S. Mann

MANY questions in regard to the use of superheated steam can be answered mathematically by reference to some of the older laws usually applied to the behavior of water vapor. There are, however, questions of a very practical nature which, while they may or may not fall actually into the category of mathematical problems, are of vital importance in determining the practical advantages in the use of high temperatures.

A portion of any saving to come from the adoption of superheated steam for power generation purposes will depend upon the ease or difficulty encountered in making and in handling it in a steam station. Laws governing the generation and subsequent action of saturated steam are understood. There are some features in the action of superheated steam, however, for which there may be a perfectly plausible and scientific explanation, but which are in a sense unexpected and which can be provided for in a practical way without a complete analytic explanation if the facts are understood; the mere knowledge of such facts will make it possible to guard against error in design of steam chambers and piping systems.

These paragraphs will relate some of the experiences met in a plant of 8000 boiler horsepower, generating steam of 185 lb. pressure and 200 deg. F. superheat.

The superheaters are a part of the boilers. There are 3 banks of tubes in a complete unit which make up the heating surface, and the middle one of these banks forms the superheater. The water-tube heating surface measures 400 sq. ft. in area and the superheating tube surface 1700 sq. ft. The stokers are of the underfeed type and the air supply comes to the fire under pressure.

Furnace temperature is about 2400 deg. F., and the temperature of the furnace gases is about 900 deg. F. when they encounter the second or superheater bank of tubes. With steady fires and with a boiler steaming at normal rating the superheat is very close to 200 deg. F. In one boiler trial having a feed temperature of 118 deg. F., the superheat was 205 deg. F., the boiler rating being 102 per cent., that is 2 per cent in excess of normal capacity, and other trials have varied but slightly from these results.

Gases leaving the superheater bank have a temperature of 615 deg. F., and at the uptake this temperature has fallen to 445 deg. F. or 135 deg. below the temperature of the outgoing steam.

When one of these boilers was first started up, it was felt that great care should be taken to avoid overheating the superheater tubes. Provision was made for flooding the surface exposed to the gases and the superheater was filled full of water and gradually drawn down until it was filled entirely with steam as the fires gained in temperature and steam was raised so that there was a flow through the tubes. It is well nigh impossible to injure superheater tubes when boilers are put in service in this way. There is a disadvantage, however, in that there may be a deposit of very dirty water in the superheater tubes and the ability to start in a simple way is to be desired.

It was found on trial that it was unnecessary to flood the superheater in starting new fires and that the tubes and joints would withstand any stresses put upon them provided the fire was started slowly, perhaps a little more slowly than would be considered safe practice with a regular saturated steam boiler.

The superheater tubes are heavy wrought-steel and are weldless. Very little trouble has been met in the care and management of the boiler and superheater. Some of the tubes have been re-rolled after the boiler was put in service; but in no case has a tube been re-rolled more than once and the boilers have been in use about 2 years. Not a single tube has been taken out or been injured in any way.

The degree of superheat is fairly uniform for moderate changes in the amount of steam delivered. The hotter the fire, the hotter the gases about the superheater tubes; but at the same time more steam is passing through the superheater tubes and there is more substance to absorb heat. During a day's run the temperature will not vary more than 40 deg., provided the feed water has a regular temperature. When the fires are cleaned, however, and there is no steam flowing through the superheater tubes, the steam that is there becomes hotter, averaging 30 deg. above the maximum of the day.

It is possible by forcing fires to increase the degree of superheat to 320 deg. F., giving a final temperature of 692 deg., and even at this temperature there is no trouble with the superheater though the gases entering the superheater bank are well on to 1200 deg. in temperature.

It has been found that it is possible to have superheated steam and water in the same vessel. This is true even when every opportunity is given to steam to pick up the water and diminish its own superheat.

The superheater is made up of 2 horizontal drums about 8 ft. apart, one placed almost directly over the other with 2-in. tubes extending from the lower to the upper. Steam enters the upper drum, makes 2 downward and 2 upward passes between the drums and leaves the upper drum to go to the steam system.

There is no deposit of water in the lower drum while the boiler is making steam. If, however, the boiler stops steaming and the fires are held in check long enough to allow the furnace gases to cool down, there is a deposit of water in the lower superheater drum. If this water is allowed to accumulate, there is a very considerable amount to be dealt with in the morning, 4 or 5 in. along the bottom of the drum, perhaps.

When the fires are brought up again, the outgoing steam is superheated in a very short time fully up to the regular average; but the water in the bottom drum is not absorbed by the hot steam sweeping over it. The surface of the water being some 20 sq. ft. in area, the steam superheated on an average of 100 deg. passing over it at the rate of about 3 ft. a second, it would appear that this whole volume of water should be taken up and made into steam in less than 30 min., particularly as the water itself is at the boiling point, or very near it. This water is not taken up by the steam, however. It lies in the bottom of the drum until it is drawn out through a drain pipe.

Even though the rate of travel of the steam over the surface is slow, there is a decided tendency of the steam to pick this water up in slugs and carry it as

*Journal Franklin Institute.

water over to the steam pipe and into the steam ports and passages; and so far as it has been possible to observe, there is very little tendency to evaporate this water. It collects until there is an appreciable volume and then it is delivered in a body with the steam current.

As a consequence of this action, all low points and pockets in a system intended to convey superheated steam, must be drained as carefully as if the same system were to be used for saturated steam. It will not do to depend upon the supposed readiness of superheated steam to absorb water as it passes above the water surface.

It is not intended to give the idea that superheated steam will of itself deposit water as it travels through a pipe; but, if the water is there, it will not be absorbed gradually until it has all nicely disappeared. It is picked up in slugs and there is the same danger from water hammer that is met with in saturated steam pipe systems.

Friction of superheated steam within a pipe appears to be greater than the friction of saturated steam. It has been found economical to give the steam high velocity because of the relatively low radiation loss and, though the actual drop in pressure is relatively larger, it may not be a mistake to submit to the loss of pressure from the boiler in order to avoid radiation losses from the pipe system. In the plant above described the velocity is about 50 ft. a second through a system complicated by many elbows.

The question of pipe covering is an important one, as the temperature difference, which is a factor contributing toward the loss in pipe radiation, is over 60 per cent greater at regular loads and 90 per cent greater at overloads, so that roughly there is 60 per cent greater chance for loss than would be met under like conditions with saturated steam. It has been found a money-saving plan to use covering 2 in. thick on saturated steam work. After careful calculations had been made a thickness of 4.5 in. was chosen for the plant under consideration and when this covering was put on, great care was used to make good joints between covering sections, all possible leaks through covering and between covering and pipe walls being stopped up.

This thickness of covering was applied to pipe and flanges alike, the covering forming a compact body from end to end. The covering over the body of the pipe is finished with a canvas jacket; but this canvas is not carried over the flanges because of the fire risk.

In laying out a system of pipe, particular attention must be given to provision for expansion of long lines. This is true of lines conveying saturated steam and more than ever true with steam at 580 deg. F. The expansion is about double what it is in an ordinary pipe system, 3 in. to every 100 ft. being the average for covered pipe, and branches 100 ft. from an anchor point must be long enough to give 3 in. safety, if the main is put up cold and is cut to exact length.

It is not difficult to find a form of steam pipe joint which will be tight for superheated steam at the pressures and temperatures under discussion. It may not overstate the case to say that any good joint that would be adapted for saturated steam of equal pressure will hold superheated steam. The question of gaskets, however, must be considered carefully, and it is extremely easy to be deceived by the action of a gasket.

Out of 7 sorts of gaskets not one has been proved a failure during a 3 months' trial. The real test of a gasket, however, is found in the number of times which it will successfully go through the operation of resisting the passage of water of condensation and whatever water may come from the lowering of pressure and drawing down the main and through stagnant steam in the pipe for a more or less extended period. What is really wanted is a packing that will always act in a predetermined way under certain stated conditions.

Certain metal joints have served the purpose for over a year and there are joints in the station under discussion that have stood for 2 yr., undergoing such changes in temperature a great many times. It frequently happens, however, that a pipe joint adjacent to one of these joints which have stood so well, both provided with metal gaskets, will fail in 3 or 4 months and be unreliable in every way.

While the metal gasket is not to be condemned, the success of some of the sheet packings has been so marked that for general work they may be safely chosen. All of the more successful sorts have a great deal of asbestos in their makeup; in fact, there are 4 kinds of asbestos sheet packing in use at the station now and there is but 1 failure charged against these 4. It seems safe to say, that, if the joints face up fair and are provided with plenty of good stout bolts and the flanges themselves are heavy, no great difficulty will be experienced in making sound joints.

The difficulties met in the handling of superheated steam are not severe, are not of a character that cannot be overcome, and the additional expense, over and above that met in a saturated steam plant, is trivial.

At Big Creek, about 80 miles east of Fresno, Calif., an immense hydraulic development will soon be started by the Pacific Light & Power Corporation, involving the construction of 2 plants and the ultimate supply of 300,000 hp. to Los Angeles.

A dam 160 ft. high by 2700 ft. in length will be built on Big Creek, impounding a lake 6 miles long by 1.5 miles wide, and from this the water will be carried 3.5 miles through a 12-ft. tunnel, where it will drop 2100 ft. in the space of 0.5 mile to the first of the power houses. Then the water will be carried 6 miles further and will drop 1900 ft. to a second power house through 4 penstocks, each 9 ft. 6 in. in diameter at the top, and discharging through a 4-in. nozzle onto the impulse water wheels.

The power stations will be 143 ft. in height, 171 ft. in length and 84 ft. in width. Secondary dams will be erected at the power stations, 90 and 75 ft. in height respectively.

From the second power station a transmission line 240 miles in length will carry current at 150,000 volts to Los Angeles. The reservoir capacity of the system will be sufficient to furnish a year's supply of water, even if no rain were to fall.

In order to build this system, a railroad connection has been run from near Fresno some 60 miles into the mountains, and 2 inclines built, up which freight engines have been hauled to be used on the bed of the storage reservoir in clearing timber and carrying sand and gravel. The dams will call for more than 3500 cars of cement and the force employed will be 3000 men during the construction period. The total freight required for the first installation, the 2 power stations mentioned, reaches 7000 cars, or 150,000 tons.

HORIZONTAL CURTIS STEAM TURBINES

Instructions for Installing and Operating Turbines

MANY of the directions for the installation and maintenance of Curtis vertical turbines which have been published in Practical Engineer within the past year apply to the horizontal type, so that only specific directions applying to the latter are given in this article.

Foundation and Alinement

THE pier underneath the middle bearing should be a solid wall and the turbine foundation as a whole should be isolated from the foundation or walls of the building. All air passages in the foundation under the generator should be painted with asphaltum to avoid dust, and suitable openings in the foundation should be provided for connection to the condenser. The base should

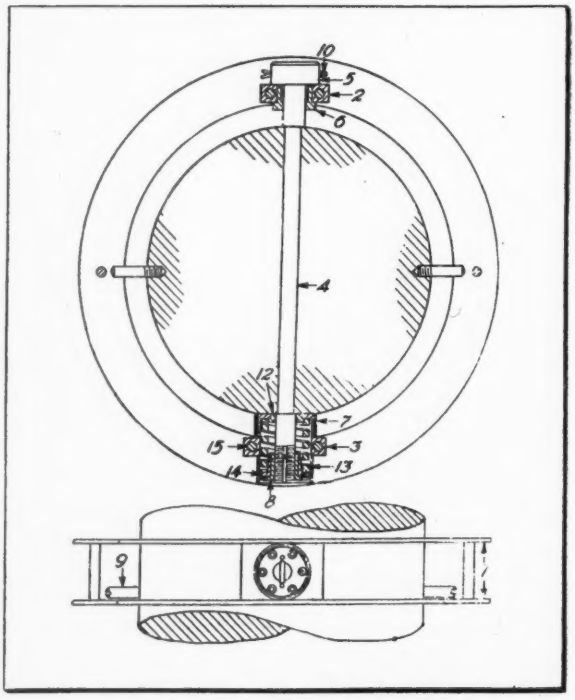


FIG. 1. EMERGENCY GOVERNOR

1, Emergency governor ring; 2, Emergency governor guide block; 3, Emergency governor spring box; 4, Emergency governor spindle; 5, Emergency governor stop; 6, Bushing for (2); 7, Collar for (3); 8, Adjusting nut for (4); 9, Guide pin for (1); 10, Cotter pin for (5); 12, Bushing for (3); 13, Emergency governor spring; 14, Support for (13); 15, Rivet for (1), (2) and (3).

be supported on each of the long sides of its foundation by iron wedges or shims about 4 ft. apart. These should be of sufficient thickness to raise the base 1 in. clear of the foundation surface to which it is to be grouted. Around the foundation bolt holes there are machined bosses which can be used for accurately leveling the base; and in machines that are shipped disassembled when ready to start lining up, the pedestals should be set on the base and alinement made by a tight line through the pedestals with bearing shells in position, particular attention being given to the turbine end bearing, to insure proper alinement of this bearing at each end, as a slight variation in the position of this pedestal will interfere with the satisfactory operation of the worm and worm wheel governor drive.

To compensate for expansion and wear of bearings, the shims for pedestals and generator, which are marked at the factory for identification, should be placed in their respective positions. No shims should be used between the supporting pads of base and the feet of turbine.

Emergency Governor

IT is important that all steam turbines be equipped with a simple speed limiting device which will operate in case the regular governing device should fail. The standard device used on these machines is shown in Fig. 1.

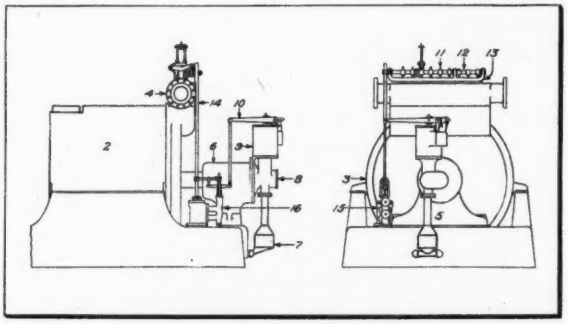


FIG. 2. ARRANGEMENT OF HYDRAULIC MECHANISM

1, Turbine base; 2, Turbine casing, top half; 3, Turbine head; 4, Valve casing; 5, Standard for turbine end bearing; 6, Cap for turbine and bearing; 7, Gear oil pump; 8, Gear casing; 9, Governor dome; 10, Governor beam; 11, Cam; 12, Cam shaft; 13, Cam shaft bracket; 14, Piston rod; 15, Hydraulic cylinder; 16, Pilot valve chest.

It consists of 2 rings of steel encircling the shaft and riveted to a block and a spring box; and the whole mechanism is supported by a bolt or spindle passing through the shaft and held rigidly in place against a shoulder by a cottered nut. The guide block is fitted with a bronze bushing through which the shank of the cottered nut may slide.

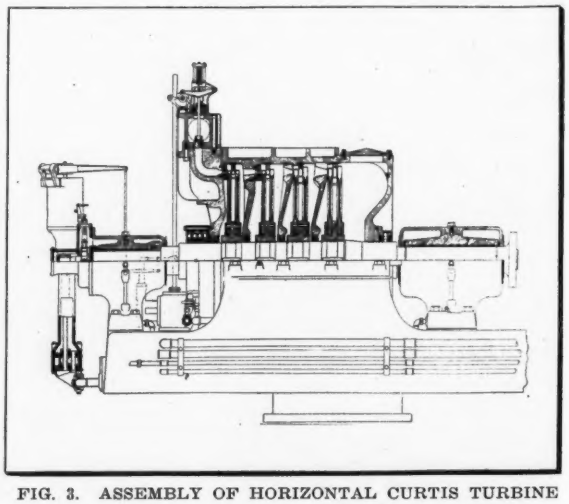


FIG. 3. ASSEMBLY OF HORIZONTAL CURTIS TURBINE

The spring box contains a spring which is pressed against the bottom of the box by the adjusting nut which is threaded on the supporting bolt. The guide pins prevent the mechanism from leaving its proper plane of rotation when starting and stopping. The emergency governor can be removed from its position without disturbing the adjustment by simply removing the cotter

pin and nut, and then drawing the bolt with nut and spring through the shaft. In assembling, draw the cottered nut up tight and be sure to place the cotter pin in position properly spread. The only adjustment of the governor is the tightening or loosening of the spring to raise or lower respectively the tripping speed.

The emergency governor is normally carried by the shaft in a concentric position. The trip finger is set ⅛ in. from the rings when they are concentric with the shaft. The governor is slightly unbalanced and the centrifugal strain of this unbalancing is counteracted by the helical spring. When the speed increases to 10 per cent above normal this centrifugal effort overcomes the spring, and the rings move out at the spring side into an eccentric position. In this position they strike the trip finger

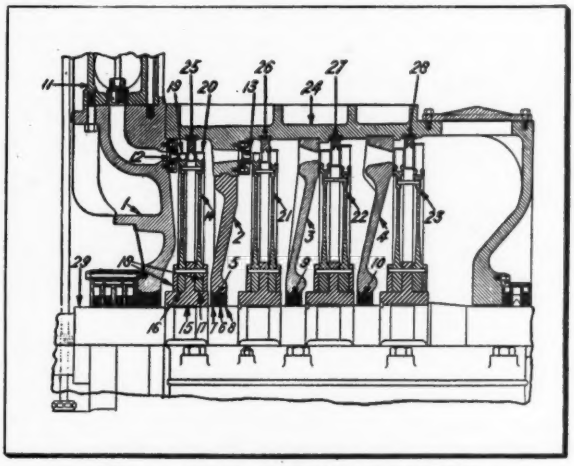


FIG. 4. CROSS SECTION OF TURBINE

1, Turbine head with bolts; 2, First diaphragm with centering pins; 3, Second diaphragm with centering pins; 4, Third diaphragm with centering pins; 5, First diaphragm packing; 6, Sleeve for packing; 7, First retaining ring with rivets; 8, Second retaining ring with rivets; 9, Second diaphragm packing (same components); 10, Third diaphragm packing (same components); 11, Valve casing; 12, First stage nozzle with bolts and locking device; 13, Second stage nozzle with bolts and locking device; 14, First stage wheel; 15, Bucket wheel spider; 16, First wheel disk with rivets and spacer; 17, Second wheel disk with rivets and spacer; 18, Collars with rivets and spacer; 19, First row bucket wheel segments with rivets; 20, Second row bucket wheel segments with rivets; 21, Second stage wheel (same components); 22, Third stage wheel (same components); 23, Fourth stage wheel (same components); 24, Intermediate holder, upper half; 25, First stage intermediate segment complete with calking keys; 26, Second stage intermediate segment complete with calking keys; 27, Third stage intermediate segment complete with calking keys; 28, Fourth stage intermediate segment complete with calking keys; 29, Turbine shaft.

or lever of the tripping mechanism which trips the throttle valve. It is essential when the emergency trips that the steam valve shall close tightly to bring the turbine to rest.

Mechanism of the emergency governor should be thoroughly understood by everyone who has to do with the operation of the turbine, as there is no other device upon which so much depends. The governor should be frequently inspected and systematically operated at regular intervals so as to guard against the possibility of deterioration or variation of adjustment. No turbine should be kept in service unless it is known that this device is in a reliable condition.

In case the emergency governor has been slushed with anti-rusting compound, this part should be taken apart and thoroughly cleaned before it is re-assembled.

Thrusts, Bearings and Lubrication

THREE main bearings of the set as well as the governor and pump drive are supplied with forced lubrication from the gear pump shown in Fig. 2.

Bolted to the turbine end pillow block is a bearing supporting a vertical shaft extending down into the pump casing. This shaft is driven by a worm and gear from the main shaft. The upper end of the shaft supports the operating governor and to the lower end is attached the gear oil pump. The axial thrust on this shaft is taken up by the thrust bearing, located above the bronze bushing which is pressed into the top of gear casing. On the base is provided an auxiliary steam driven pump, which is to be used in starting, in order to avoid cutting of the main bearings before the turbine gets up to such speed as to give the proper oil pressure, or in case of accident to the gear pump.

End play of the main shaft is limited at each end of the turbine end bearing by roller thrust bearings. Each of these thrusts consists of 2 hardened steel plates with roller cage; the latter being self-contained so that there are no loose rollers.

The end play and position of the wheels are adjusted by "U" shaped shims placed between the stationary thrust washers and the ends of the bearing. The thrusts are lubricated by the overflow from the main

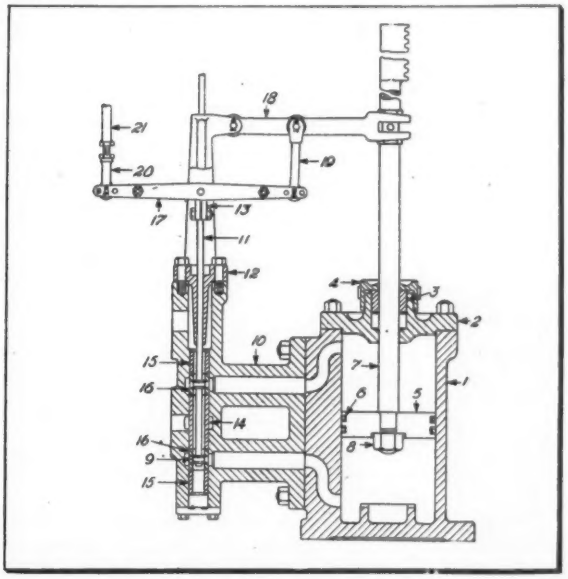


FIG. 5. HYDRAULIC OPERATING CYLINDER AND PILOT VALVE

1, Hydraulic cylinder; 2, Cylinder head; 3, Stuffing gland for (2); 4, Nut for stuffing box; 5, Piston; 6, Piston ring; 7, Piston rod; 8, Piston rod nut; 9, Pilot valve; 10, Pilot valve chest; 11, Pilot valve stem; 12, Pilot valve stem guide; 13, Pilot valve pivot clamp; 14, Pilot valve middle bushing; 15, Pilot valve end bushing; 16, Pilot valve seat bushing (hardened steel); 17, Floating lever; 18, Differential lever; 19, Link for (18); 20, Rod end— adjustable; 21, Connection to governor lever.

bearing. Pressure gages are attached to the system to show the pressure of oil, and a pressure of approximately 75 lb. should be maintained on the hydraulic cylinder, this pressure may be regulated by the ¾-in. relief valve placed above and discharging into the oil reservoir. An oil pressure of from 15 lb. minimum to 25 lb. maximum is sufficient for the main bearings and is adjusted by the handwheel of the baffler, which is a device for reducing the oil pressure.

All pressure gages furnished with the turbine should be throttled sufficiently to reduce needless vibration and consequent wear on the internal mechanism.

Oil is cooled as it circulates through the main bearing linings, the bottom halves of which are equipped with a number of coils of copper pipe imbedded in the babbitt. The inlet and outlet connections to these coils are made from the outside of the main bearing pedestals and it is

necessary to break these connections before removing the lining. Each branch is provided with a plug valve for adjusting the supply of water to the bearing it feeds. The discharged water passes through a sight discharge coupling into the drain pipe.

This system of lubrication is perfectly reliable and needs little attention. It is important that the oil be absolutely free from all substances, such as particles of waste or grit, and to guard against the introduction of any foreign matter, 2 strainers are attached to the bracket which is bolted to the end cover on the oil reservoir in the base of the turbine and through which the oil flows to the pump. By removing top cover of the oil reservoir the strainers may be taken out for examination or cleaning, whether the turbine is in operation or not. One strainer should be taken out at a time, cleaned and replaced before removing the second one. In addition there is a cheese cloth strainer placed over the metal strainers through which the oil is poured through the top opening when first filling reservoir. The oil in the reservoir should stand a little below the top of the strainers.

COMPRESSED AIR-HUMIDITY PROBLEM

By Frank Richards

I WAS much interested in the "Air Compressor Problem" of E. S. R. in Practical Engineer for March 15, and I regret to say that the solution offered by J. R. Morton in the June 1 issue, changing the location of the pipes leading into and out of the air receiver, cannot be regarded as complete or satisfactory. Indeed, it is not easy to state the problem involved, and still less the solution of it, without the use of many words.

In this case, it will be remembered, compressed air was used for blowing out electric generators, with the not unfamiliar result that the air jet delivered also more or less water, and the question arose as to how to be able to deliver dry air.

To begin with, there is practically no such thing as dry air. So far as the water nuisance is concerned, it generally makes little actual difference where the air is taken from, as all atmospheric air, free air, carries moisture, and when air is sufficiently compressed it has more moisture than it can carry, and then the released water becomes a nuisance or worse, as in the case under consideration. The problem is to get rid of the surplus moisture before it can cause trouble, and the conditions of air compression and transmission generally furnish the opportunity, however little it may heretofore have been availed of.

In the daily meteorological reports in the papers the humidity of the air is one of the most important items, and it shows a much wider range of fluctuation and more rapid changes than either the temperature or the barometric pressure, which suggests what an active business is done by the atmosphere in the water carrying line.

The capacity of air for moisture, up to the point of saturation, depends upon both its volume and its temperature. If the volume of any given quantity of air is reduced by compression, or increase of pressure, its capacity for moisture will be reduced in almost direct proportion. With a reported humidity of 50 per cent for atmospheric air, which is not far from the average in many localities, if the air were compressed to 2 atmospheres, or say 15 lb., gage, then it would be saturated, or the humidity would be 100 per cent, or the air would have all the moisture it could carry in the form of intimately commingled vapor.

If the same air were compressed to 4 atmospheres, or say 45 lb., gage, then one half of the moisture in it at the beginning would immediately cease to be true vapor and would be condensed into real water, although it would still be distributed through the air in minute globules. If during the operations here suggested this air were enclosed in glass it would be seen to be perfectly transparent until the point of saturation was reached, and after that the condensed moisture would give it a misty or foggy appearance. This released water still in the air would wet anything with which it came in contact, and if the air was stationary or moving slowly in large pipes the water would gradually settle down through the air and be deposited along the bottom surface of whatever it was contained in.

For the air and its load of moisture to act as here described we have had to assume one impossible condition. We have ignored the fact that the compressing of the air always raises its temperature, and that the changing temperature of the air has more to do with its moisture carrying capacity than has the reduction of its volume. The hotter the air is the greater is its capacity for aqueous vapor, and the raising of the temperature of the air by the operation of compressing it increases its moisture carrying capacity more rapidly than the reduction of volume reduces that capacity, and the actual compression brings the air to the end of the operation sensibly dryer instead of wetter than at the beginning, although the actual water content has not been changed.

The moment, however, that the compressed air has been delivered by the compressor into the pipes or receiver its moisture capacity begins to change rapidly, because the temperature of the air falls at once. Unless the air is used immediately after it is compressed, and very near the compressor, its heat of compression is all dissipated, its temperature falls to that of its surroundings, and both the conditions of reduced volume and reduced temperature are combined in their effect to reduce to the minimum the vapor carrying capacity of the air and to set free a large portion of the water it contained when the compression began. The air will then inevitably be more than saturated with vapor and will contain actual water all through it, and it can only be described as very wet air.

If this air, without anything being done to it, is used for almost any mechanical purpose the water will make itself manifest, and almost invariably in a more or less undesirable way, but if while the air is at its highest pressure and its lowest temperature the air is drained of its entrained water by passing through a separator—a steam separator of any of the usual types does the work very well—then the water will not be heard from later. If the air under full pressure is transmitted through pipes for a considerable distance the water will drop out of it and flow along the bottom of the pipe, and if this water is not drawn off from pockets which should be provided, then in the final rush of the air as it leaves the pipe to do its work the water will be picked up and carried along and will be just as bad as if it had never been deposited by the air at all. The actual separating and drawing off of the water after it has been released by the super-saturated air is a point which has been too frequently neglected.

MISDIRECTED ENERGY

Success at Last and the Burning of Bridges

By I. H. P.

TIME rolled on, as time will roll—

"Colts grew horses, beards turned gray,
Deacon and deaconess passed away"—

and the gas engine rolled also—intermittently.

The engine-room force became more and more familiar with its idiosyncrasies and peculiarities, and at the mastery of each trick they thought it to be the last, but lo! they discovered there were more worlds to conquer.

When they weren't redesigning and rebuilding mufflers to replace those partially wrecked by a few charges which were not exploded in the cylinder, but were later on in the muffler, they were taking off cylinder-heads to get at the lime deposits left in the water-jacket. And when they weren't doing that they were renewing the threads in the 8-in. exhaust flanges immediately adjacent to the cylinder, until they prevailed upon the manager to order the pipe and flange cast together.

One night the wheel moved an inch along the shaft, presumably due to a slightly increased speed, raised to take care of an abnormally heavy jag. The following day the 16-ton wheel was jacked back to position, and the 4 hub-bolts shrunk in, a formality the road-man did not deem necessary.

And as for valve grinding, they waxed fat on it. In short, life was one glad round of startling uncertainties. It is said that variety is the spice of life. If so, they had a surfeit of it. There seems no end of varied forms of cussedness every full-grown gas engine is familiar with, and this particular one had mastered every detail.

But the engine-room force were learning and the daily report sheet with its footnotes and diagnosis looked like a map of the Russian retreat after the battle of Mukden.

About the only part of the apparatus which caused a feeling of relief to steal over the wan and worried features, were the producers. As soon as the proper size of coal had been found; one which produced a fire that permitted being thoroughly cleaned without falling down onto the grates, prematurely, all was serene in the fire-room, and the performance exceeded the most sanguine expectations.

All this time, patient reader, be it known that the old water-tube and center-crank were kept in trim so that at short notice they could be up and away and grind out volts and amperes when occasion required, and their mere presence were worth their weight in gold in confidence to the worried force. This force stood aghast in dismay one fine day when the boss dropped in on them and spoke of his intention of selling the steam rig and doing it quick and even went so far as to voice an opinion that all their gas trouble was due to the fact that the steam was in running order. Accordingly, on the following day, he ordered the stack taken down and before a month had rolled by the place was denuded, stack, boiler, pumps, engine, feed-water heater; all were things of the past and it hardly seemed like home.

Fancy a power station without a stack! But, strange to say this device worked like a charm and the ceaseless cough of the monster went on uninterruptedly. But the fear was still in their hearts, and it was only with bated breath and crossed fingers that they spoke of the wonderful performance, and agreed among themselves that the manager was skating on thin ice.

But a pleasant surprise was in store for them, and the glad news soon went forth that a new engine had been purchased; one smaller in size but of the same make and design; one which would handle the light load from midnight to morning more economically and yet large enough to carry a good share of the maximum load while necessary to repair the large unit.

The night man was busy with his slide-rule one night, on the old problem of the vacuum bottle, or why it stays cold longer than it does hot, when his student friends appeared on the scene and after a few introductory commonplaces, wanted to know how the ratio between the circumference and diameter of a circle, 3.14159, was determined, and why one should multiply the square of the diameter by 0.7854 to get the area of a circle, and where 0.7854 came from.

After sizing up the bunch to make sure they weren't guying him, he lighted his postprandial stogie and remarked that such ignorance was refreshing.

"And in your junior year, too. What do they teach you there? Anything useful, I wonder? Here, take this reach-rod which happens to be one inch in diameter. Now, take that piece of tape and wrap around it, getting the circumference exactly. Stretch your tape out and measure it in inches and tenths and tell what you get."

A few seconds of painstaking effort brought forth the answer, 3.15 in.

"Is that the best you could do?" grunted he of the stogie. It seems to me that you could have come closer than that. I'll tell you now what you ought to have had, and I don't want you to forget it: 3.141592653589+, and the plus on the end means, 'and then some.'"

Of course he had to say it all over again while 3 pencils jotted down the figures in as many note books, amid laughter and expression of surprised wonderment.

And as for the 0.7854, suppose we take this same circle of one inch diameter, and circumference of 3.1416. Suppose we cut it up pie fashion into very small pieces and sandwich them together, and we now have the radius, or .5 in. for one side, and 3.1416 ÷ 2, or 1.5708 in. for the other side. Then the product of these two gives us the area of 0.7854 sq. in. Nothing very hard about that, that I can see."

"You're so blamed smart with your figures. We learned a new one today in physics class," spoke up one of the trio, "and perhaps you're not familiar with how to determine the polarity of wires?"

"What kind of currents? Alternating?"

"Now, don't get funny and I'll tell you. You place the 2 opposite polarities in water and the one that is negative will bubble."

"And I'll tell you one, more complex and amusing than that," retorted the other. "Just remember the word 'snow,' and you've got it."

"What has snow got to do with it?"

"I'll tell you. First, get a pocket compass, magnetic needle, you know; then get a circuit with current flowing. Now! Use a Single wire; there's S. We'll assume the current flows North; there's N. Place wire Over compass; there's O. Then the needle will point West; and there's W. Now I guess I'll have to tear myself away from this learned gathering, and poke down my fires."

(To be continued.)

Electrical Machinery and Appliances

For Generating, Transmitting and Using Current

CONDUIT WIRING

Laying Out and Making Bends

By O. N. Casey

PROPERLY bent conduit turns look better than elbows, and are, therefore, preferable for exposed work, see Fig. 1. If bends are formed to a chalk line, the conduits can be made to lie parallel at a turn in a multiple run, as shown in Fig. 1. If standard elbows are used, it is impossible to make them lie parallel at the turns, as different sizes are bent to different radii.

Laying Out Curve

TO lay out a right-angle conduit bend, draw a chalk line diagram of the contour of the bend on the floor as follows, see Fig. 2. Draw a base line CO of

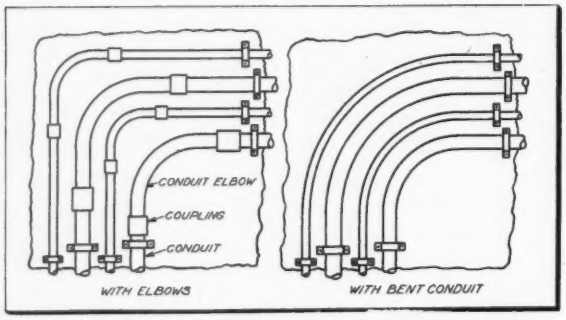


FIG. 1. COMPARISON OF ELBOWS AND BENT CONDUIT

any length. Lay off AO 4 units long. (The units may be any dimension whatever). With a cord and a piece of chalk, with O as a center, and a radius of 3 units, describe the arc VJ. With A as a center and

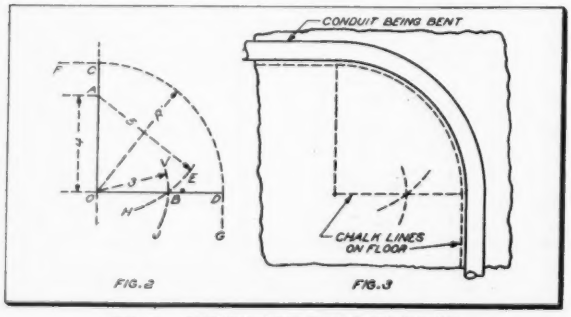


FIG. 2. LAYING OUT PATTERN CURVE
FIG. 3. TESTING CONDUIT BEND BY CURVE

a radius of 5 units, describe the arc HE. The line OD drawn from O through B, the intersection of the 2 arcs, will be at right angles with CO. CO and OD may now be prolonged for any desired distance. The arc CD is drawn with the cord and chalk with any required radius R. The conduit bend should lie parallel to this arc when the bend is laid on the floor for inspection, as shown in Fig. 3. Table I p. 264, Mar. 1 issue, column D shows the minimum radii that should be used for conduit bends.

Tools for Bending

HAND conduit benders are shown in Fig. 4. Many satisfactory commercial benders are obtainable, but they usually have the disadvantage that the work must be carried to them to be bent. The hickeys shown at I can be used anywhere, hence are very popular. For ½ to ¾-in. conduit, the pipe bender should be a 1-in. tee and pipe. A bender with a grooved metal wheel, that anyone can make, is shown at II.

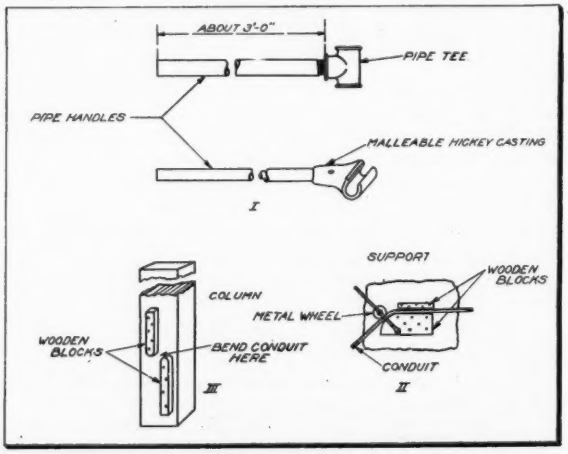


FIG. 4. TYPICAL HAND CONDUIT BENDERS

The arrangement of III can be used for large conduit. It consists of 2 heavy wooden blocks bolted to a column or other substantial vertical support.

A home-made hickey can be constructed from an ordinary malleable iron pipe tee, by sawing a slot lengthwise in its side. As suggested in Fig. 5, the slot I, II, III, IV should be wide enough to admit readily the conduit that is to be bent. The provision of the slot results in the saving of considerable time, as compared with the time required where a pipe tee hickey must be slipped over the end of the conduit each time a bend is to be formed.

A good, simple arrangement for bending heavy conduit is illustrated in Fig. 6. A length of timber at least 8 by 8 in. in cross section, is wedged between

the floor and the ceiling of the building in which the conduit installation is to be made, and the conduit is bent by being gripped in a hole cut slanting through the timber, as illustrated. The hole should be large enough to accommodate the largest conduit used on the job. If small sizes of conduit are to be bent, a wooden block can be inserted in the bottom of the hole; thus reducing its effective diameter.

It is often economical to make such a timber for bending, of oak, so that it will stand up under the severe usage that it receives, and can be carried from job to job. In order to secure sufficient leverage, a length of conduit of larger diameter than that being bent, can be pushed over the piece that is being formed, providing a long handle. In bending with this arrangement a good portion of the bend is first made on one side of the timber and the bend is then finished on the other side of the timber.

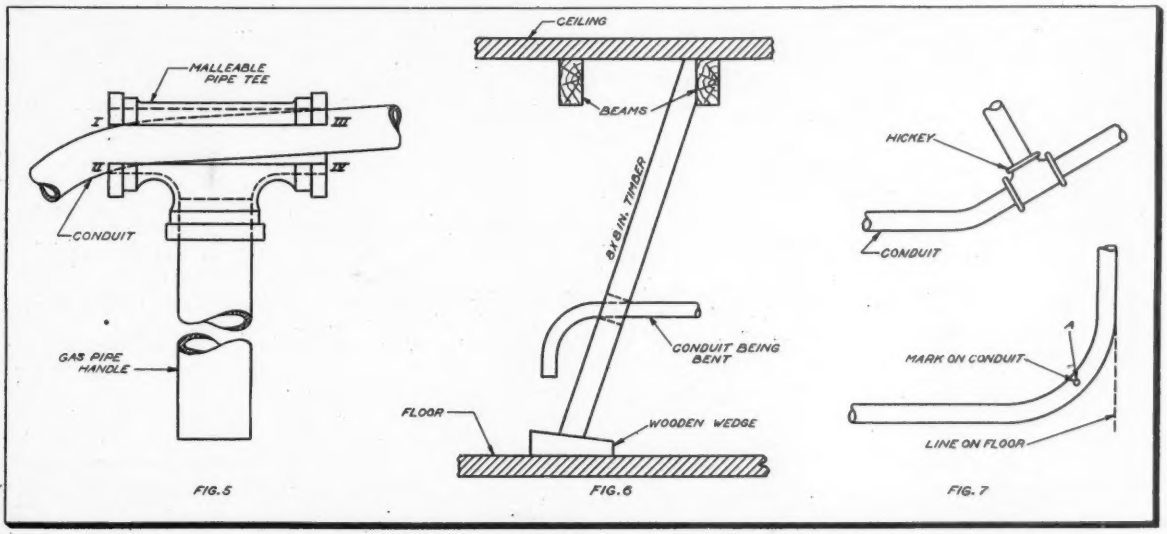


FIG. 5. HOME-MADE SLOTTED HICKEY FOR BENDING CONDUIT FIG. 6. METHOD FOR BENDING HEAVY CONDUIT
FIG. 7. BENDING CONDUIT BY HAND

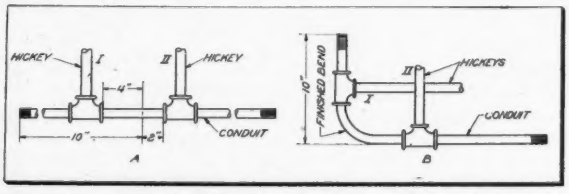


FIG. 8. USING 2 HICKEYS TO BEND SMALL CONDUIT

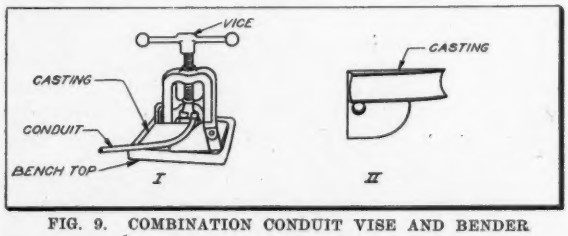


FIG. 9. COMBINATION CONDUIT VISE AND BENDER

Making the Bend

TO bend conduit by hand, butt the end in which the bend is not to be made, against a wall or other vertical substantial object, and mark off on the floor with a line, the point where the bend should come. Slip the bender onto the pipe to a point within a couple of inches of the mark. Then bend the conduit about 20 deg., Fig. 7. Move the bender back an inch or so and bend some more. Repeat until the bend assumes the proper form. Make all bends with as large a radius as possible. The minimum radius of inside of bend for any bend, is 3½ in. Where a line is drawn on the floor, as in Fig. 2, conduit can be bent accurately to it, but if a mark is placed only on the conduit as at A, it is very difficult to make a proper bend.

Figure 8 illustrates a good method of bending small conduit with 2 hickeys. The following directions apply to the formation of a 90-deg. bend, other angles can be readily bent from the directions given. Where the conduit is of ½-in. nominal diameter, indicate the length of the portion of the conduit that is to be at right angles to the main portion. In Fig. 8 it is assumed that this length is 10 in. Indicate with the chalk a point 2 in. further along the main length and place one of the hickeys at this point; then at a position 6 in. from hickey II, place the other hickey I. Hold one of them securely and swing the other around

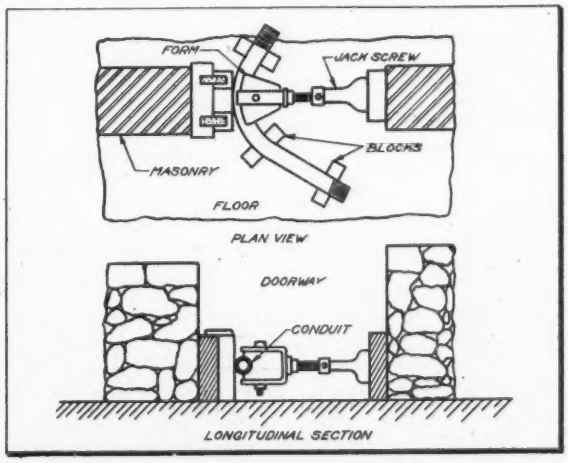


FIG. 10. BENDING LARGE CONDUIT WITH SPECIAL JACKSCREW

through an angle of 90 deg., and the bend will be formed as indicated. Where ¾-in. conduit is being bent, the distance between the hickeys should be 8 in. spaced 5 in. and 3 in. For 1-in. conduit, the hickeys should be located 10 in. apart, spaced 6 in. and 4 in. from center of bend.

A combination conduit vise and bender for conduit of the smaller sizes, is shown in Fig. 9. By bolting the casting shown at II to a commercial vise, the arrangement shown at I results.

For Large Conduit

A RIG for cold bending large conduit is shown in Fig. 10, and can be set up in a doorway or between any strong vertical supports. It is usually cheaper to bend large elbows than to buy them. Always lay out a chalk line on the floor, to bend to before starting. In forming a bend, start at one end of the curve that is to be, bend a little with the jackscrew and then take the conduit out and to the chalk line and compare it therewith. Proceed thus until the bend required is

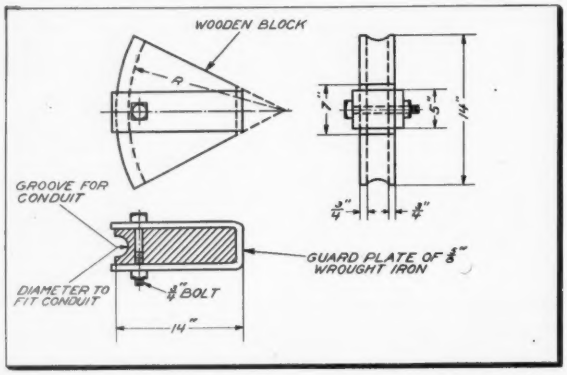


FIG. 11. DETAIL OF WOODEN FORM FOR ATTACHING TO JACK SCREW

formed. A hydraulic, rather than a screw jack, may be necessary for conduits larger than 2 in. in diameter.

The wooden form, by means of which the jackscrew's pressure is applied to the conduit, is detailed in Fig. 11. It should be of a hard, close-grained wood, such as maple, with the diameter of the groove a trifle larger than that of the conduit and iron strap to reinforce the groove. There should be a block for each size conduit, but sometimes a conduit can be successfully bent with a block for a larger size, although if the groove does not fit, the pipe may crush. The bolt should fit tight in the hole in the block or the block may crush. The radii R should be about those of standard elbows, as given in Table I already quoted. The minimum inside radius is 3½ in.

DID MOTOR DRIVES PAY?

An Analysis of a Report of Central Station Engineer Shows Many Discrepancies

By Henry D. Jackson

A SMALL factory plant has recently been equipped with motor drives, this equipment being installed after a report had been submitted by the central station solicitor for the purpose of interesting the factory owner in these drives. The report as submitted is decidedly interesting when one takes into account the different possible view points. It is evident that the report was written from the view point of a central station engineer for the express purpose of interesting the plant owner in central station power. It might be quite as interesting to the plant owner and others if this report were rearranged from the view point of the consulting engineer so as to show them how matters would stand if an unbiased report were submitted.

In the report the fixed expenses were as follows:

Taxes, interest and insurance	$240.00
Depreciation	200.00
Maintenance and repairs	250.00

At a fair valuation of the plant, these items would show that the taxes, interest and insurance are taken at 8 per cent, depreciation at 6.7 per cent, maintenance and repairs at 8.3 per cent; making the total fixed charges on the plant 23 per cent.

Certain changes were made in the plant. These consisted of installing 28 motors at a cost of $3200. The wiring cost $700 additional; making the total cost of the changes $3900.

Assuming that the original plant cost $3000, and that the engine, countershafts and useless belts were sold at a price of $500, which is probably all that could be obtained for them, as second-hand engines bring a very low price and the cost of removal is heavy, we would then have $2500 of the original investment still subject to interest on the basis of $1500 being the value of the boiler, piping, etc., and $1500 that of the engine, belts and shafting. For the purpose of this discussion we will neglect the engine. So there is subject to interest, maintenance, depreciation, taxes and insurance, the boiler and appurenances of $1500 and the electrical addition of $3900, making a total of $5400.

In the report, the repairs and maintenance on this investment were taken at $30; interest, depreciation, taxes and insurance at $250; the former at the rate of 6/10 of 1 per cent, and the latter at the rate of 4.63 per cent, making the total fixed charges 5.23 per cent.

When one compares this with the fixed charges of 23 per cent under steam operation, he wonders what has happened to the other 18 per cent, and why so low fixed charges might exist in one case and so high in the other. Certainly the taxes, interest and insurance would hardly change simply because the plant was electrified, as the boiler was still in use and fire was just as likely under electrification as under steam. The boiler would be still in operation. The motors, wiring, belts, etc., are subject, with the boiler, to depreciation. If there is any doubt upon this question, one has only to try to sell a secondhand motor, and this doubt will be dispelled. The boiler is still subject to maintenance and repairs as it was before. The motors and all parts pertaining to the drives are also subject to repairs. So there is every reason to believe that the same fixed charges should be made against the plant when electrified as under the original condition.

Let us assume then that the fixed charges are taken on the rearranged plant at the same rate as on the old plant, that is, 23 per cent. The fixed charges would then be $1242.

The operating expenses in the old plant were as follows:

Coal	$1788.00
Oil, waste, etc	100.00
Water	150.00
Removal of ashes	96.00
Labor of engineer	900.00
Estimated cost of lighting	63.50

Adding to this $690 for fixed charges, the total operating cost was $3787.

Under the condition of electrification, it was figured that coal would cost $700, the removal of ashes $25, and labor $100. These represent the total operating charges under the condition of power purchased, except for the cost of the electrical power.

Let us compare these with the figures under steam operation.

The coal cost under these conditions was $1788. Under electrification it is to be $700. The cost of the removal of ashes would naturally be in direct proportion to the amount of coal, which would show that the ash removal would cost $37.50. The engineer acted as the fireman in the original plant, and it is fairly certain the largest portion of his time was taken in firing. The coal to be fired under electrification is in proportion of 700 to 1780, and the labor for firing would be in direct proportion to this. Owing to the fact that a licensed man would not be required to run a low-pressure boiler, doubtless a man could be obtained to fire at a lower rate than a licensed man, but firing coal so as to get results requires a man of more than average intelligence. Brains must be mixed with the coal. And it certainly is cheaper to pay a little more for labor and burn a great deal less coal, than to pay a low price for labor and burn a lot more coal. So $400 is not an unfair charge for a good fireman.

There are 28 motors installed. These have to be taken care of, cleaned and oiled. This might be done by any man about the plant, but what is every man's business is no man's business, and if left to any man to do, it would never be done. Further, electric motors require skilled attention in order to be kept in good operating condition and to prevent them from getting out of center, burning out the bearings and coils, and $200 would not be an excessive price for the services of a man capable of doing this work, who might, of course, be spending the rest of his time on other work about the plant.

Water will be required in the boiler for heating purposes, and as there is more or less waste under these conditions, a reasonable charge of $50 would not more than cover this item.

Oil would be required for the motor bearings and waste to keep the motors clean, and it is likely that the oil and waste required for 28 motors would be equal to if not greater than that required on the engine, so that the $100 charged against the engine might readily be charged against the motors for the same purpose.

Tabulating, we have:

Coal	$700.00
Removal of ashes	37.50
Firing	400.00
Electrician	200.00
Water	50.00
Oil, waste, etc	100.00

These figures, together with the fixed charges, and the net electric bill of $2040, would make the operating charge $4769.50, with no allowance whatever made for lighting. As the original cost, $3787.50, included lighting, it is evident that, with the fixed charges taken on the same basis, and a fair allowance made for the various operating items, the actual cost under electrification, neglecting the cost of lighting, was nearly $1000 greater than under the original conditions, all of which goes to show how easy it is to turn the balance in favor of one method or another, depending upon how the fixed charges are taken care of.

It is quite common for people interested in the installation of electric motors to state that it is very easy to take care of a plant of this character, that the motors are so simple that they require no care and that any man about the plant can take care of them, so that no time should be charged up against them; also to state that a low pressure heating boiler requires no licensed man, and as any man about the plant can fire it, no charge should be made for this purpose. These statements are inaccurate and futile. It must be evident that time is required both for care of the motors and firing the coal, and even though any man about the plant can do it, his time is taken for this purpose, and he is thus removed from other useful work, and, therefore, his time should be charged up against the work upon which he is employed.

In the original plant, it was found that the average load was 59.6 hp., this being determined from a number of indicator cards taken under average conditions of load. The friction load with everything running light was 38.1, obtained in the same way. The claim was made, therefore, that the difference, or 21.5 hp., represented the average power required for operating the machinery.

At this point there is a possibility of an error. This friction load was obtained under conditions which do not exist when the plant is in full operation, that is to say the shafting and belting were not carrying full load, and, therefore, the friction load was a good deal smaller than it would be under full load conditions. An allowance of 10 per cent as an addition to this friction would not be excessive to cover these conditions. This would make the friction load 41.9 hp., leaving 17.7 hp. as that actually required at the machinery.

What then are the possibilities in this plant other than the purchase of central station power?

A friction load of 41.9 hp. in a plant of this character and size seems excessive, and would lead one to believe that by a careful, consistent removal of the friction by lining up the shafting, revamping the belting, and generally overhauling the bearings, it could be reduced by at least 19 hp., bringing the total load to 40.6. If coal were reduced in direct proportion, there would be a saving of $570. A reduction in water and the cost of the removal of ashes would result in a saving of $48 and $32 respectively, making a total saving of $650, or even more than was figured for the introduction of the electric drive when many of the charges which should have been made had been neglected.

In the final allowance for the cost of power under electrification, no figures whatever were given for the cost of heating various solutions and tanks used in the plating process. As these were heated from the boiler in the original layout, it is evident that the coal used for this purpose was charged up against power. How were these heated under electrification?

An examination of the power used would show that the average power used during the day was 19 kw. As the total average load on the plant was 17.7 hp., it is very evident that no allowance is made in this charge for electricity for lighting, which, therefore, must be added to the cost under electrification, which would still further increase the cost under these conditions.

The total connected motor load is given as 160. The average load required is 17.7, showing that the ratio of the average load to the connected capacity is in the ratio of approximately 1 to 9. Under these conditions, in order to get drive efficiency of 70 per cent, either a large number of these motors must be idle, or the character of the motor and drive is far superior to most of those hitherto installed in this country. The

full load efficiency on the small sized motors installed would not exceed 80 per cent, and allowing 10 per cent for drive and counter shaft friction and line losses, this would account for an efficiency of 70 per cent at full load. As the motors, owing to the large capacity installed compared to the motor power actually required at the machines, must be operated at considerably below full load for a large proportion of the time, it is evident that the average drive efficiency must be considerably under 70 per cent, and, therefore, the estimate of power required is too low.

In the report, the figure of $12.80 is given as the yearly cost per connected motor horsepower. This figure means nothing. No one has any concern whatever as to what the cost is per connected horsepower. The only thing that interests anyone is the cost of power per actual horsepower delivered or used. In this case the average horsepower actually used at the machines is 17.7. The actual horsepower delivered is 25.5. Now, the figure which is interesting to the owner is the cost of power either used or delivered, and in this case, as the cost of power includes a great deal more than the net electrical bill, it figures out to $263+ per horsepower used under electrification, and $214 per horsepower used under the original conditions, still noting that under the original conditions the cost of lighting is included, whereas under the conditions of electrification, the cost of lighting is not, nor is the cost of heating the vats, etc.

Did it actually pay, therefore, to install electric drives? Would it not have been more to the point to have attempted to clear up the friction and improve the conditions in the steam plant rather than to install electric motors?

Electrification with power purchased from an outside source of supply can only be made successful when the cost of power as purchased outside is low enough to enable the installation to be made so that the decrease in the actual cost of power as purchased will offset the increased fixed charges which may be brought about by the installation of the motors, etc.

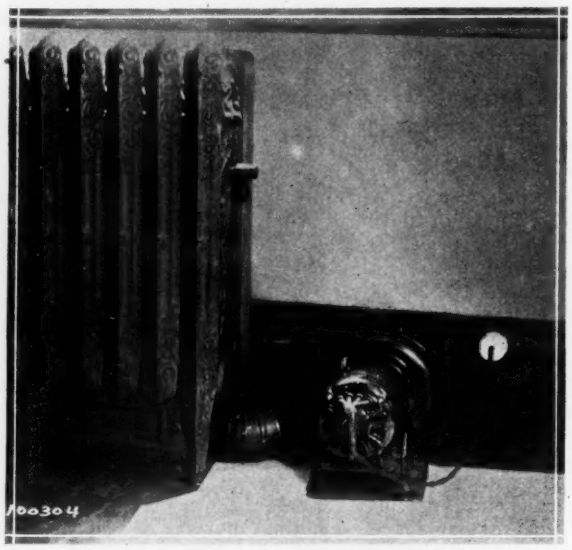
It is common practice for the central station engineers to make heavy fixed charges against all steam plants and practically neglect the fixed charges on the plant under conditions of electrification. That this is unjust and unfair must be evident to anyone who will reason the matter out. Interest, taxes, and insurance are items which are absolutely unaffected by the character of the installation. Depreciation depends entirely upon the life of the apparatus. Maintenance and repairs depend largely upon the character of the apparatus, and the care which is devoted to it; but no type of apparatus, electrical or otherwise, can go indefinitely without repairs, as anyone must recognize, for mechanical apparatus or electrical apparatus, so long as it is moving, is subject to wear and tear. This inevitably calls for replacement; and there is always a possibility of serious damage to electrical apparatus either by overload or lack of care, all of which must be recognized and prepared for under the head of maintenance and repairs.

VENTILATING A LARGE BUILDING

WHEN the imposing Pennsylvania Station at Pittsburgh was originally planned, it was equipped with what was at that time considered a thoroughly adequate ventilating system. The waiting rooms were furnished with fresh air by large motor-driven fans, and the offices were served by a system of ducts which communicated with the outside air, the natural draught being depended on for circulation.

But as the offices became more crowded, and especially as the officials began to realize the importance of an ample supply of fresh air in rendering employes comfortable and efficient, it became evident that the natural draught was not sufficient and some other arrangement must be made.

The problem was solved economically and effectively by installing in each office needing it a small motor-driven ventilating set consisting of a Westinghouse motor and a Sirocco blower. As shown in the illustration, the set is placed on the floor near



SMALL MOTOR-DRIVEN VENTILATING SET

the radiator. It draws fresh air in through the existing ducts and forces it out through the radiator, thus filling the room with fresh warm air. Current is obtained from the lighting circuit. In some inside offices, the sets are used in summer as well as in winter.

This arrangement is ideal for ventilating buildings not equipped with modern ventilating plants. The set is quiet, takes up very little room, and needs no attention beyond lubrication every few months. A large volume of air is handled at quite a high pressure. The sets are furnished in several different sizes to suit various conditions.

IN THE PRESENCE of a large number of state officials and prominent visitors, at Speigner, Ala., on July 5, Governor O'Neal pressed the button that started the new hydro-electric power plant and set the machinery of the cotton mill in motion.

To the convicts assembled before him the governor uttered words of cheer and hope, telling them that their reform was the principal object to be accomplished in their incarceration, and that the revenue which they brought the state was purely a secondary consideration. Regarding his recent order for the removal of shackles from convicts, the governor declared that he was determined that his decree should be carried out.

It is estimated that the $100,000 power plant will furnish 500 hp., and that the capacity of the mill will be trebled.

LIQUID RHEOSTATS FOR LARGE A-C MOTORS

USE of large alternating-current slip-ring motors for driving mine hoists, winding gears, rolling mills, etc., has increased largely during the past few years and has created a demand for a simple, efficient and economical controller. To meet this demand the Westinghouse liquid rheostat has been developed.

These rheostats provide an infinite number of steps between minimum and maximum limits, thus permitting fine speed adjustments and very smooth acceleration. The rate of acceleration can be definitely fixed and is independent of the rate at which the operator manipulates the starting lever; it is then impossible to injure the motor or the machine it drives by too rapid acceleration.

The entire apparatus is very simple in construction and very reliable in operation. There are but few parts susceptible to wear or deterioration, and these can be easily and cheaply renewed.

The principle of operation of these rheostats is clearly shown by the accompanying diagram. The rheostat consists of 2 compartments, an upper tank for the electrodes, and a lower reservoir. The 3 phases of the rotor are connected to electrodes suspended in the upper tank. A small motor-driven pump pumps a steady stream of liquid, usually a solution of soda, from the reservoir into the electrode tank, and back into the reservoir over a weir. Now by raising or lowering the weir, the height of the liquid in the electrode tank is correspondingly varied.

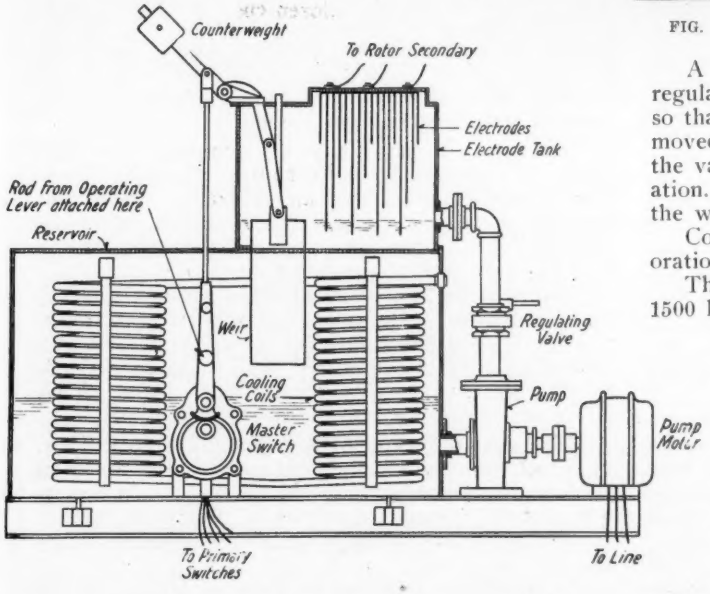


FIG. 2. CROSS SECTION OF LIQUID RHEOSTAT

The resistance of the rotor circuit decreases as the liquid level rises, and vice versa, and the motor speed of course, changes with the rotor resistance.

The primary circuit of the motor is closed and opened by means of electrically operated switches, which are controlled by a master switch mounted on the rheostat.

The operating lever of the rheostat controls both the master switch and the weir. When the lever is in the central, or off, position, the primary switches are open and the weir is at its lowest level, so that the secondary resistance is maximum. Moving the lever in one direction closes the proper primary switches for starting the motor forward and raises the weir. Moving the lever in the opposite direction, reverses the motor and again raises the weir.

Speed control is secured by varying the position of the weir by moving the lever; the primary switches do not open until the lever is placed in the off position.

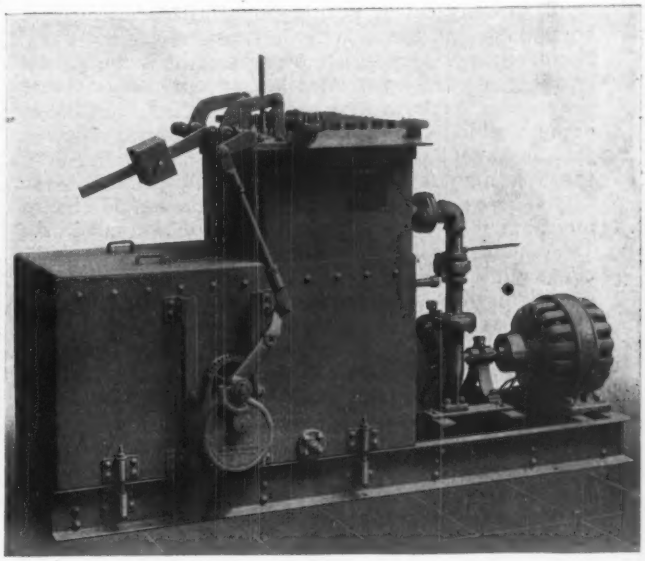


FIG. 1. LIQUID RHEOSTAT FOR USE IN STARTING MOTORS

A valve in the intake pipe of the electrode tank regulates the rate at which the liquid is pumped in, so that no matter how quickly the operating lever is moved, the liquid can only rise at the rate for which the valve is adjusted, thus fixing the rate of acceleration. When the lever is returned to the off position, the weir drops and the liquid level promptly falls.

Cooling coils in the reservoir prevent rapid evaporation of the liquid.

These rheostat are made in capacities from 400 to 1500 hp.

FOR THE DESTRUCTION of refuse, the Sterling Destructor, installed by the Griscom-Russell Co., at Halifax, Nova Scotia, has given some gratifying results on test. With a grate area of 75 sq. ft., used under an Abendroth-Root water-tube boiler, with heating surface of 2034 sq. ft., a refuse consisting of 75 per cent ashes, 16 per cent wet garbage and 9 per cent rubbish, was burned at an average rate of 77.7 lb. per square foot of grate per hour, evaporating water from a feed temperature of 40 deg., and at a pressure of 145 lb. gage, to give 258 boiler horsepower, the equivalent evaporation from and at 212 deg. per pound of refuse being 1.52 lb. To secure this combustion, the air pressure in the ash pit was 2.72 in. of water furnished by a fan. A clinkering period of 8 min. was required, with an interval between periods averaging 92 min. This rate of combustion, 70 tons in 24 hr., exceeded the guaranteed capacity by 40 per cent. Analysis of the residues of one test showed 40 per cent fine dust, 37 per cent ash, and 23 per cent clinker.

THE ROADMAN IN MEXICO

He Erects Some Engines in Mexico During the "Revolutionary Age," and Has an Exciting Time Sidestepping Real Trouble

By Geo. H. Wallace

"HI, there!" I thought it was some disgruntled citizen with a genuine grouch hailing a street car. But again it came, a little more sharply and distinctly.

"Hello! Hi, there!" and I turned to see Dave Griswold, the city editor of the Journal, he of the patent home-made shorthand fame, hurrying along the street behind me. I waited a moment till he came abeam on the "lubbard" bow, when he hailed me in a manner usual with a fellow who has put in more than 35 yr. doing nothing but running down murders, suicides, weddings, and political intrigues in one of the most thriving manufacturing centers in the middle west.

"Where are you going? What's the news? Know anything that is good dope for the public?" inquired Dave with the bruskness of a rapid fire gun as he came within range.

"Going down to pay my grocery bill. News? Why, lots of it. I just saw the Roadman go into Herman's cigar store in tow of Dude Foster, Bob Anderson, Albert Falk and Bert Ellis, and as he has just returned from the peaceful community below the Rio Grande, I guess that he will have something to say that will melt the type off the press."

"Thunder and lightning, t'ell y'say. And I haven't got only one pad of paper," says Dave in desperation.

"Well, what of that?" said I. "Here, take the back of my grocery bill. That's big enough to record a week's doings of the suffragette convention on. Take it and welcome," and we passed into the cigar store.

"And you can take it from me that the next time there is an engine to erect in the forsaken wilderness of sagebrush and revolutions, that the old man can go down and erect it himself. I have had all the experience, looking down the business end of a rifle and dodging bullets of all calibers, that I care about," were the words that burst on our ears as we opened the door.

The Roadman was sitting with his back to us and we slipped into a couple of chairs at a near-by table. Dave threw me a few pencils to sharpen. He was about 7 laps behind, but that is nothing. He has been known to memorize the county election returns and swim a river to get in a scoop. At once the hen tracks began to follow in rapid order across the grocery bill.

"Trouble? Why, you fellows don't know what trouble is. For several months, I never expected my hide to hold corn in the ear from one day to the next. Revolution was in the air. Everybody was fighting—even the dogs, the fleas and the bedbugs," the Roadman continued, puffing a weed.

"I have been down there several times before when there wasn't more than one revolution a month or so, and never had any serious trouble. The first time, I provided myself with a passport at El Paso, but it never seemed to be necessary, so I did not take the trouble to get another one on later trips.

"I was sent down to a place near Chihuahua to set up some engines and a revolution sprang up with the suddenness of a cyclone. Traffic had been suspended, and I had to have a permit from General Orasco, I guess was his name,—makes no difference,—so as to go down on the military train.

"We rode down for quite a ways, stopping frequently to repair the track, when all of a sudden there was a fusillade as we passed into a cut, at about 8 miles an hour. Did you boys ever kick a bee hive? No? Good! Well the way those greasers tumbled out on the other side of the train was a caution.

"By the time the train came to a stop, there wasn't a light of glass or a soldier in sight. There were 4 Americans on the train and aside from a well developed pompadour and a disinclination of the hat to lie down, we were still unpunctured. We took reserved seats on the rear coach and witnessed one of those comic opera battles that Mexico is famous for.

"It looked for all the world like these battles you see in the 'movies.' Suddenly, the attacking party made a rush at the Rebels, and it was surprising how swift they were at surrendering. If there is one thing that a Mexican likes to do more than another, it is to be on the winning side.

"As the Rebels (then, but Federals of late) had been augmented by a large body of recruits obtained by capture, it wasn't possible for them all to ride in the train, and it was decided to put a guard on the train for us so we Americans couldn't 'revolute' ourselves, consisting of half a dozen cigarette fiends, and then we proceeded.

"In about half an hour, we stopped at a water tank out in the middle of the most forlorn and Godforsaken place ever imagined. The sun beat down on the bare ground and wherever you looked, the horizon disappeared in the crinkly heat waves. A Mexican officer, called Major by our guard of honor, came in and demanded our passports.

"This was where we were stumped. We had none. A drummer for a Pittsburgh machinery company quickly pulled out an insurance policy, all trimmed up in golden seals and flourishes, which he waved before his majesty, saying that it was for the 4 of us,—we were all on one ticket.

"'No sabe banyana, non chili-con-carne, el hot tamale, mutchah-cho el Capitan Colonel,' said the Major, and we all concluded that he spoke the truth. We had no proof to the contrary. So we passed out into the burning desert. The town had no name. That is, we saw no sign on the depot—such as it was.

"But near the water tank was a 'dobe hut in front of which were the Colonel and about half a dozen of the toughest looking greasers that I had yet seen. The Colonel assumed a job lot of dignity as we approached and looked daggers at us. We had no weapons to look in reply.

"The officers jabbered a while in Mex., and the Major politely stood us up against the wall of the 'dobe shack. I remember well that there were a number of suspicious looking holes in it as we were being led to it, and when I turned around and faced those greasers, each one was fingering the trigger of his rifle in a manner that boded no good for us.

"While the officers discussed the best way to do the job, we were looking at each other wondering how it would feel to be hit by bullets of 6 different calibers at about 10 yards. The station agent strolled

up just then and as he looked like an American soldier of fortune,—possibly misfortune,—the machinery drummer hailed him about like this:

"'Say, is it customary to ventilate a fellow's system down here like this without the formality of a little law?' To which the agent replied in badly sprained English that it wasn't, but had been done on a few occasions, in an emergency like this one.

"We inquired what the rumpus was about. He juggled diplomacy with the officers in a reckless manner, during which the Major pointed to my indicator box and said something about 'inferno machino go-bango,' or something like that, which was interpreted to us to the effect that we were suspected of being a gang of some kind of carpetbaggers on the way down to the Capitol to put a giant cracker under the unpeaceful couch of the 'El Presidende' who just then happened to have hold of the Johnson bar of State.

"The extra hunk of cord was construed to be a supply of fuses, and when the Colonel tried to set fire to the end of the cord with a match and it didn't burn, he made a few remarks, using the word 'agua' several times, and we concluded that he thought the fuse was wet.

"Our lives were spared, but they confiscated the indicator in the interests of peace and harmony. What they intended to do with it out in that desert with nothing to attach it to but the water tank or a handcar, is more than I know.

"When we were allowed to board the train and proceed, we all breathed a sigh of relief. Let me tell you, it was a mighty sober bunch that combed our hair once more to make it lie down, as we steamed southward.

"Well, at last we arrived at the place, where we were met by an American superintendent who was still storming about having had to pay in the neighborhood of $400 taxes on a little shack that would pass the graft ridden politicians in some of the northern cities for about $30 a year.

"I put up at a hotel, so called, and soon was well taken up with erecting the engines at the smelter. Time passed quickly, even with the aggravating help that we had. Their only creed is: 'Never do anything today if you can possibly put it off till tomorrow except smoking cigarettes and starting a revolution, and when you do get a chance to do anyone, do him first and good and plenty.'

"One day, as we were busy trying to make the machinery run at the smelter, there was the awfulest racket you ever heard and you could hear the bullets strike the corrugated iron like pouring shot into a dish-pan. The helpers all cut for safety, and, in fact, it didn't need urging for me to do so also, especially as a stray bullet had come in from some place and put the receiver gage out of commission.

"The Federals and Rebels had evidently come upon each other unexpectedly right around the smelter and both sides had cannon and one side a machine gun of some kind. Finally, as all good things have to come to an end, the racket simmered down to a few sputtering shots like a bunch of firecrackers and then—stopped. Not hearing any signs of a renewal of the squabble for about an hour, I stole out like the comedian in a burlesque show, and finding nothing around but a few dead ones, we came out of our hole and took stock.

"Some of the boilers had been filled to the top because the Mexican fireman had let the feed valves open when he made his escape. Others were without a drop in the glass. But that power house was a wreck. It looked like a big nutmeg grater and there wasn't a whole sash of glass in any of the windows.

"One side or the other had accidentally shot a hole through one of the steel stacks with a cannon, that put a crimp in the draft and the high power, Krag and Mauser steel bullets had even gone through, too, while the big .45 Springfields made a dent like a sledge.

"You could have swept up a peck of bullets where they had struck against obstructions and dropped to the floor. We had quite a time clearing away the wreck and getting the plant going again, but finally I got an acceptance and pulled out.

"From there I went to a little town with an unpronounceable name to fix up some after a battle had left things a little stirred up. This place looked like the other one and we soon fixed things up—till the next revolution.

"About this time a letter reached me that had been about 3 weeks in getting to me, with a little money in it, which was very welcome. Also instructions to go to another smelter and erect 2 engines, down in the interior about 150 miles farther.

"Here's where fate swatted us a few. This was quite a job and it kept me pretty well occupied for several weeks, during which time it was next to impossible to get word to or from the firm up in Milwaukee or friends and relatives elsewhere. Funds were absolutely minus. The banks were closed, as were practically all of the stores. Every few days, one side or the other would ride into town, shoot things up a little, loot a store of what they wanted or could carry away and disappear in a cloud of dust.

"Finally, after living on the generosity of an American official of the smelting company for weeks, enough money arrived so I could square up and leave, and, believe me, I headed straight for the Rio Grande. Right here I parted company with my tool chest, however, and when I struck El Paso all I had was a level and a pair of gas pliers in my grip, and my trunk of personal effects,—all that were left.

"I wired the house and was ordered to a town in Texas to erect a refrigerating outfit, which I did with the assistance of the tools the engineer loaned me. During this time, things had been quieting down a little in Mexico, so far as the outside world could learn. However, when the average greaser learns what a snap it is to have a pony, rifle, saddle, and a few dollars a month furnished,—the easiest time he ever had in all his life,—it is almost impossible to get the 'revolution fever' out of his system without resorting to violence.

"From Texas, I went clear down to the City of Mexico on a job, where I landed and completed the work just in time to participate in the grand round-up between Diaz and Madero, terminating with the assassination of the latter.

"This was real war, and it was what General Sherman said it was, too. Those 2 weeks were the longest that I ever put in, in all my life. See those gray hairs? Well, when I left Texas for the scene of trouble my hair was without a gray streak.

"Boys, I have been mixed up in some bad scrapes in my day. A runaway engine, a ruptured tube, the explosion of a receiver tank, the failure of a 6-in. tee and water hammer knocking the bonnet off a 5-in. valve, but never in all my life have I passed through a series of events like those few days in Mexico City.

"As soon as it was possible, I dug right out for God's country, up here in the good old United States."

FOREIGN DEVELOPMENT IN THE POWER PLANT FIELD

Hydraulic Turbine with a Double Crown of Vanes*

By J. H. Blakey

THE Voith Co., of Heidenheim, Wurttemberg, Germany, has patented in France an invention relating to exterior radial injection turbines under the form of turbines with a double crown of vanes and known by the name of Francis stage turbines, which it seems interesting to describe.

This kind of turbine presents the inconvenience, when the 2 crowns of vanes have a common diffuser, and when one of the crowns is put out of action by the distributor apparatus, that the diffuser is much too large for the second crown, and that in addition the crown of vanes which is not being driven turns in the water and produces a back-wash which must lower considerably the efficiency of the turbine.

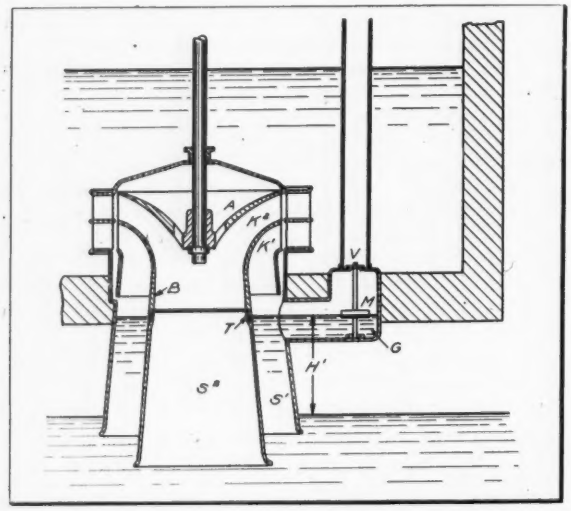


FIG. 1. FRANCIS STAGE TURBINE CONTROLLED BY HEIGHT OF WATER IN DIFFUSER OF THE LOWER CROWN

It has already been proposed to employ, for multiple turbines, several concentric diffusers, in number corresponding to the number of crowns, and by this means to avoid the difficulty of having the area of the diffuser too great for a crown which may be working alone. This, however, would not remove the objection spoken of, that any crown of vanes which is not adding to the efficiency of the machine is taking from it, if it turns in the water.

In this turbine an attempt has been made to overcome this difficulty. Figures 1 and 2 represent 2 methods of working; regulation being accomplished by means of a float. The motor wheel A of a double crown turbine consists of the upper crown K^2 and the lower K^1. The lower crown is in connection with the diffuser S^1 while the upper debouches into S^2. The motor wheel rests on the diffuser S^2 at the joint T. The diffuser S^1, which belongs to the crown of vanes which may be isolated, is in communication in Fig. 1 with a reservoir G, arranged at the height of the desired level. In this reservoir, which is air tight, is a float M carrying the valve V for the admission of air. The float M keeps the valve closed when the water is at the required level. If the water rises the float opens the valve and allows the admission of air until the water has regained the required level.

In the method of working shown in Fig. 2 the diffuser S^1 is in communication above with the required level by means of a tube R connecting with the air-tight reservoir G. In this the float M carries the admission valve W. A vertical pipe U connects the reservoir G with a second reservoir F containing water. In consequence of the air-tight communication existing between G and the chamber S^1, which is in depression, the water will mount in the reservoir G until the height H^2 is equal to H^1, which is the height of the water in the diffuser above the lower level. Into the reservoir F is poured such a quantity of water that, for the desired height of the water in the diffuser above the lower level, the level of the water in G brings the float into such a position that the valve W is maintained just closed. If then the rarefaction of the air in the diffuser chamber S^1 increases and the water rises, the depression becomes equally greater in the reservoir G, the water in G rises and the valve W is opened. The entrance of air will have the effect of lowering the water level in G and in S^1 by exactly the same amount, and the valve will close.

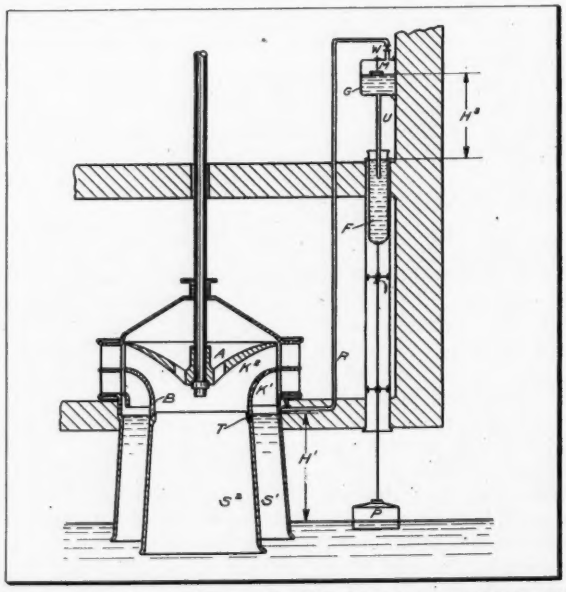


FIG. 2. CONTROL SYSTEM OF FRANCIS STAGE TURBINE DEPENDING UPON LEVEL IN DIFFUSER AND DISCHARGE

Reservoirs G and F instead of being filled with water may contain some liquid, such as mercury or oil, in which case the height H^2 will be less than H^1 in proportion to the difference of the specific gravities of the 2 liquids.

The aspiration height H^1 changes with the rise and fall of the water level, and in order to permit the admission of air through the valve W the level of the liquid in the reservoir F must also be changed in order to maintain the level in the diffuser at the proper height. This can be done by hand by raising or lowering the reservoir, or by adding to or taking

*Translated from the "Revue Industrielle," Jan. 25.

from the amount of liquid in it. It may be done automatically, as shown in Fig. 2, by connecting the reservoir with the float P, resting on the surface of the discharge water and rising and falling with it.

If there is used some other liquid than water in the reservoirs G and F it will be necessary to interpose a connection having a suitable multiplication. The air connection can be cut off from the diffuser by means of the valve W.

Instead of admitting air into the exterior diffuser S^1 it may be admitted into the interior diffuser S^2, in this case the upper crown of vanes does not operate.

The regulation of the heights H^1 and H^2 is arbitrary, and depends upon local conditions. In practice the level of the water in the diffuser S^1 must just reach or cover the joint T. Instead of 2 crowns it is possible to have 3 or more, any one of which may be isolated by the same method.

HEAT AND COLD INSULATION*

By H. W. Prentis, Jr.

IN recent years we have heard much of X rays and radium; how the vibrations or waves, or whatever you choose to call them, thrown off by this marvelous substance will penetrate many solids and affect photographic plates through inches of dense material. Yet, while we are reading of radium there is an equally marvelous phenomenon going on all around us. Heat is being generated by the sun, in our own bodies in fact, and is being thrown out into the ether with such power and energy that there is nothing that can stop it. Its waves pass through all substances; hence every minute, day and night, the heat is leaking out of your boilers and steam lines, or conversely, into your cold storage rooms, and brine and ammonia piping. Coal is being shoveled under your boilers, machinery is wearing out, operating expense is piling up every minute that passes. Common sense naturally asks, are your steam lines, are your boilers, are your cold pipes, are your cold storage rooms properly insulated? For only by suitably protecting them from the onslaughts of heat, by scientifically insulating, in other words, can this constant drain on your resources be minimized.

First of all, we will agree it must be a good nonconductor of heat. But upon what does the nonconducting value of any material depend? To answer this question intelligibly requires a brief explanation of the theory of heat transmission.

Heat has 3 ways of getting about: It can pass through space on the ether waves without appreciably heating the air. Stand in front of a hot stove and the truth of this assertion is self-evident, or perhaps, the sensation of warmth that one feels in bright sunlight on a cold day is a better explanation of the radiation of heat, as this method of its transference is called.

When the problem of heat insulation is under consideration, however, the other ways that heat moves are of more importance. By conduction is meant the transfer of heat from one particle of matter to another by the impact of the molecules composing the substance itself.

Now no material is an absolute nonconductor. Some, however, obstruct its passage more than others. The heat conductivity of heavy, dense substances is very high; that of lighter materials is less, probably because the molecules are not so close together. Wood transmits less heat than metal. The heat conductivity of gases is still less; hence air, the most available gas, is the most efficient insulator that can be had, if a vacuum, which is commercially impracticable on a large scale, be left out of consideration.

The difficulty, however, is to confine air so that it cannot circulate. For the transference of heat is effected also by a third means, called convection, the carrying of heat from one point or object to another through the agency of any moving gas or fluid. The ordinary hot water heating system is a good illustration. The hot water rises through pipes to the rooms that are to be warmed and drops as it becomes cool, thus automatically setting up circulation.

*An address delivered before the Kansas Gas, Water, Electric Light & Street Railway Association, at Manhattan, Kansas.

Good Insulation for Heat and Cold

A PROCESS similar to this, but on a miniature scale, takes place in every form of heat insulation. The larger the spaces in which the entrapped air is confined, the more rapidly will heat pass from one side to the other; therefore, the material that affords the best insulation is that which embodies the greatest number of the smallest possible air spaces, for the smaller the air spaces, the less extensive is the effect of the circulation of the air confined therein. In other words, the nonconducting efficiency of any insulating material depends on the volume of "dead air" it contains.

But there are a number of other requirements which must be met before any material can be considered a satisfactory heat insulating medium. In the first place, it must be durable. To this end, 3 things are essential:

1. The material must have a certain amount of structural strength and flexibility so that it can be applied without undue breakage and withstand ordinary wear and tear.

2. It should be, so far as possible, proof against moisture and steam. If not, the first time the line springs a leak a large portion of the covering will be ruined.

3. It should be able to withstand the temperatures to which it will be exposed without any actual deterioration of its physical structure.

Furthermore, expediency demands that whatever material is used should be easy to apply, as this reduces the cost of installation. It should, moreover, be neat and symmetrical and not bulging and unsightly in appearance. Last, but not least, it must be reasonable in cost, taking into consideration not only first cost but cost in the long run.

While all these essentials apply with equal force to insulation for either hot or cold surfaces, there is one point in connection with covering for cold surfaces that should be particularly emphasized. The service conditions, which such covering has to meet, are far more severe than in the case of insulation for hot pipes or boilers. With the latter, the internal heat tends to keep the covering, whatever it may be, dry and efficient.

With cold pipes the conditions are exactly reversed. The air in the air-spaces in the covering close to the pipe is cooled down as soon as the refrigeration is turned on. As the air cools, it contracts. This produces a partial vacuum and at once the atmosphere presses in, endeavoring to restore equilibrium. If nature is successful, if the outside air can force its way in, the ultimate fate of the covering is assured. For

the warm air will carry in moisture as vapor, which will condense as soon as it is cooled, and be deposited right in the heart of the covering.

This process will go on every moment that the plant is in operation. The air spaces in the covering will soon fill up with frost. As soon as the refrigeration is turned off the frost will melt, the covering will be thoroughly saturated, and this will render it worthless from an insulating standpoint, since water is a good conductor of heat.

When the refrigeration is turned on again, the water will freeze, disrupt the covering and ultimately cause its complete destruction. It is obvious, therefore, that any material used for covering cold surfaces must be both air- and moisture-proof, not only that its efficiency may be lasting, but that the covering itself may prove reasonably durable in service.

Of insulation for steam lines and boilers, coverings made of magnesia, of asbestos, and of diatomaceous earth, are probably the most prominent. The last named is comparatively new, and has attracted considerable attention owing to its high efficiency and the fact that it will withstand repeated wetting and drying without injury.

For the insulation of brine, ammonia and ice water lines, a variety of coverings can also be had, composed usually of hair-felt, wool-felt, or cork, some of the cheaper types even of paper or rope. The felt coverings are very efficient for this class of service, provided they can be kept dry; but, unfortunately, it is well-nigh impossible to accomplish this and at the same time keep the cost of application within reasonable limits, owing to the fact that all such coverings are composed of fibrous substances, possessing marked capillary action.

Chiefly for this reason, coverings made of cork are being adopted more and more generally for cold pipes. Their first cost is no greater than for felt-covering properly applied, and in durability they are probably far superior. There have been a number of well-authenticated instances in which they have lasted on brine and ammonia lines until the pipes have worn out from the inside, that is for 10 or 11 years.

Whatever materials you decide to use in your plant, be sure that you use them scientifically. While, of course, it is possible to put on too much insulation, the chances are that the average purchaser will not err on that side. For some unaccountable reason, the majority of power plant owners—most of them shrewd business men—have been satisfied for years, particularly in the case of steam lines, with any sort of covering of any thickness, so long as it concealed the pipe. So little attention has been paid to this phase of power plant economy that it is no wonder that an old pipe coverer in New York boasted to me some months ago that on a job where there were a lot of pipes to cover up against the ceiling of a high boiler-room, he simply went along and whitewashed them, not taking the trouble to cover them at all. And the owners never knew the difference.

Insulating Correctly

NOW you would not think of buying an engine or a generator unless, on actual test, it showed that it had the capacity which the manufacturer claimed for it. Moreover, you would not buy it in a haphazard way. You would figure out what amount of power you required, and compare the merits and general economy of one type of machine with that of others. Not so with steam covering. In 9 cases out of 10, the chances are that anything that is cheap and covers up the pipe will do—irrespective of the service conditions.

On the other hand, it is only fair to add that with the growth of the scientific management idea, there seems to be a slowly developing tendency toward installing pipe covering on just as careful a basis as any other piece of power-plant equipment. Only a few months ago a consulting engineer was called in to design a new power plant for the New York Rubber Co. at Matteawan, N. Y. After carefully examining all conditions, he specified that a certain 10-in. steam line 350 ft. long, 198 ft. of which was outdoors, should be insulated so that with a temperature of 0 deg. outside and 65 deg. inside, the condensation should not exceed 0.17 lb. per square foot of interior surface of the pipe.

Many manufacturers balked at making the desired guarantee. One concern that knew what its covering would do, accepted the contract; and when the acceptance test was made, after the factory had started operating, the engineer found that the covering more than fulfilled the conditions—the condensation amounting to only 0.1361 lb. per square foot of surface. If more users of steam covering would adopt such methods, they would be astounded at the saving in the coal bill.

The truth is we have been satisfied to go along for a great many years in the heat insulation business, following rule-of-thumb methods which are absolutely antiquated. It is high time that in figuring on the covering for a given job, all the various items that should determine the proper thickness of insulation to install —the temperatures, the climatic conditions, the cost of coal, etc., be taken into consideration. One reason, perhaps, why this has not been done more extensively, has been the dearth of accurate data regarding the loss of heat from bare pipe and the actual transmission through the various types of covering in ordinary use.

(To be continued.)

THE QUESTION OF WHETHER concrete can be made in itself waterproof was recently asked Leonard C. Wason, president of the Aberthaw Construction Co., Boston. In reply, Mr. Wason was very emphatic in stating that not only can concrete be made impervious under ordinary pressures but even under extraordinary pressures. By ordinary pressures is meant pressures due to heads 10 ft. or below, while extraordinary pressures refers to standpipe pressures. Mr. Wason states that his experience has shown that it is simply a question of well graded materials, proper proportions and thorough workmanship, to get the maximum density. With good work the Aberthaw Co. has found that for maximum density a mixture of 1:2:3½ is about correct, the aggregate varying from 3½:4. Mr. Wason remarked that the time the materials should mix is very important and that on the best work they have done the materials were kept in the mixer for 5 min. The amount of water is also very important. The point of placidity can be judged by the eyesight and the concrete should just barely quake. The materials after being mixed must be handled very carefully so that there will be no separation. To make impervious concrete structures, great care must be taken in getting the joints clean before going on with the next day's work. In Mr. Wason's opinion 99 per cent of all leaky concrete building work is due to poor workmanship.

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LETTERS DIRECT FROM THE PLANT

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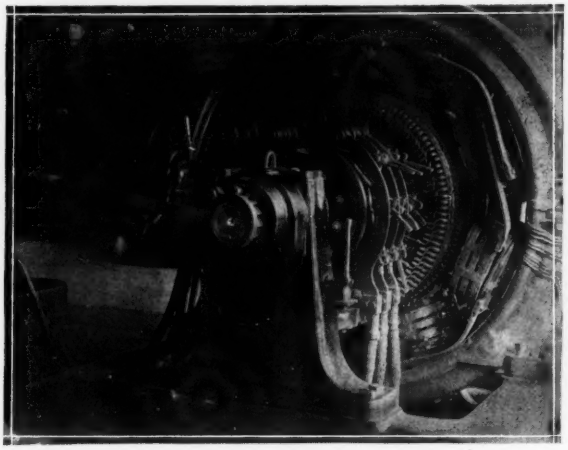
RESULTS OF USING CHEAP OIL

ILLUSTRATION shows a ratchet lever that had to be used in starting a rotary converter. With the lever, which is about 7 ft. long, it required the services of 2 men to start the armature to revolving when it was to be put in use.

When the machine was installed a cheap grade of oil was ordered to be used; after several months service it was impossible to start the machine from the



A MONUMENT TO CHEAP OIL

switchboard. An investigation proved that the chemicals in the oil had pitted or frosted the bearings and shaft very badly, causing the unusual amount of bearing friction. In order to get the machine started the ratchet lever was made, the toothed wheel being keyed to the shaft, lever and dog made so as to be removable.

Several months were required with the use of the best oil that could be purchased to bring the bearings back to normal condition.

The ratchet and lever also proved to be useful in turning the armature to clean the slots in the commutator. J. B. Linker.

A WELL KEPT CORLISS ENGINE

SIXTEEN years ago a new flouring mill was completed, which has been in operation ever since. The power plant consisted of one O'Brien boiler, Corliss heater, hot and cold water pumps, and a St. Louis Corliss engine of 60-hp. The brick work has been partly rebuilt, having slack grates still under the boiler. There have never been any blemishes on the shell of the boiler; a few flues have been put in, good pond water has been used all these years.

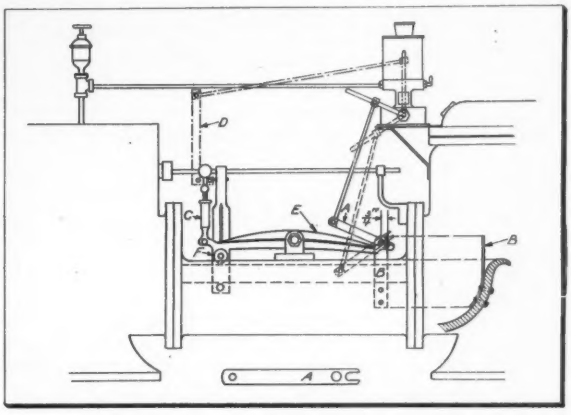
The best lubricator I ever saw has fed the cylinder, steady almost like a pump. It has a gallon reservoir bolted to the side of the cylinder, piped up to a sight feed on the steam line, this being hot, oil always finds its way to the glass. The piston head and valves have never been out of their respective places. A good card can be taken yet. No engine breakdowns have occurred but a few new parts have been put on the valve motion. The same oil cups are in use, still good.

It shows what good care, steady load, short steam line, low steam pressure, and last but not least, in all the years there have been only 5 men in charge of the plant, and 2 of these have done almost all the running. G. H. Brough.

OIL-PUMP CONNECTIONS

OUR 2 Knowles Vacuum Pumps were equipped with oil-pumps 3 yr. ago and the motion for these pumps was obtained by bolting an angle-bracket D to the link C, as indicated on the sketch by dash and dot lines.

This arrangement was very unsatisfactory. The bracket broke frequently, the bolts would work loose and fall out, the motion was jerky and noisy and often interfered with the proper working of the valve gear.



CONNECTIONS TO OIL PUMP AND DETAILS

To improve conditions I devised the arrangement shown on the sketch in full lines, which has none of the defects of the former and is very simple.

The rocker-bar E was bored and tapped at the extreme end for a ½-in. pin, this pin consisting of a piece of ½-in. round iron about 1½ in. long, threaded for about half its length, the threaded portion to screw into the rocker-bar and the other end to engage the slotted end of lever A to which it is to impart the motion and which is pivoted on an upright B, which in turn is bolted to the cradle of the pump as shown in sectional view at the right.

Lever A is made of a piece of ¼-in. by 1-in. flat iron. The distance between pin-centers is made as short as possible and is in our case ¾ in. This is important as the motion of the rocker-bar is slight

and lever A should not be made excessively long. The upright B consists of a piece of ¼-in. by 1½-in. flat iron, is rounded off at the upper end and slightly curved at the lower end to conform to the shape of the cradle to which it is bolted.

On one of our pumps we found that there was insufficient motion to make the oil-pump perform properly, but this defect was overcome by raising friction roller F slightly; this raising of the friction roller did not, as I had feared, interfere with the working of the valve gear. K. H. M.

CENTERING ENGINE; MEASURING BELT

THERE are some points on which I do not agree with others. Take, for instance, the putting of an engine on center for valve setting, many engineers say to proceed as follows: "Place the crank near the center, set one point of tram on a solid object and make a light mark where the other point touches disk or wheel, also make marks on crosshead shoe and guide, then turn wheel in direction it runs until the marks on crosshead and guide again coincide, etc., and if you move crosshead too far you must turn it back a distance and bring it up again.

I claim that, for accurate work, in getting these marks in line for the second time, on either center, the crosshead should be moved past and then brought back until the lines meet.

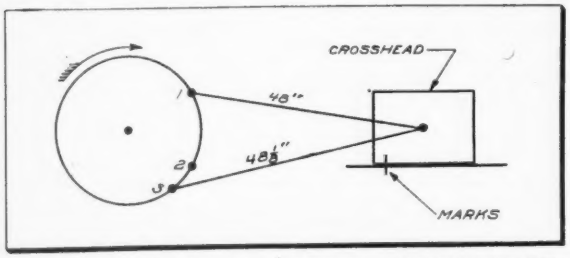


DIAGRAM OF CRANK AND CROSSHEAD WHEN CENTERING ENGINE WITH PLAY

Now consider the diagram. The crank is placed at point No. 1 as shown and marks made on crosshead and guide, also light mark with tram. The crank turns in the direction of the arrow. The connecting rod is 48 in. long.

Suppose that for some reason there is ⅛ in. play in the rod boxes. In the position shown this play will be of no consequence, but when the crank crosses the center and goes back to point No. 2, the rod will "stretch" and be 48⅛ in. long instead of 48. Therefore, the crank will be farther from the center in position 2 than it will be in position 1. Now, if it is brought on down to position 3 and then pushed back to 2, this play will be taken up.

One must remember that when the crank is on center, the eccentric is near its quarter; that is the reason so much care must be used. I know one man who boasts of his 15 yr. experience, "and can center her with his eye." I can't do it.

Another thing one sees in print is about measuring belts; some say to run a steel tape over the pulleys where the belt is to go and read the length direct. But if they don't mix a little arithmetic with it, it is likely the belt will be too short, because it is the center line of the belt that makes the length, and when the belt is wrapped around the pulley there is one-half the thickness of belt between the pulley and this center line.

Consider 2 pulleys 36 in. in diameter and 180 deg. arc of contact, belt ¼ in. thick. The center line of the belt will be ⅛ in. away from the pulleys. In this case the belt passes halfway around 2 36-in. pulleys, so we must figure as if the belt passed entirely around one 36¼ in. in diameter. If the belt was same thickness as tape then there would be no difference.

Fred Eckley.

SHOULD THE ENGINEER FURNISH TOOLS?

I BELIEVE an engineer should have his own kit of tools, not a large kit nor large tools, but a kit of small, useful tools which come handy anywhere some time, such as 2 or 3 hammers of different size and shape, small drills and bits and bit brace, small chisels of various shapes and sizes, punches, packing hooks, try square, combination square, rule, tape line, scraping tools (made from half round files), pliers, pincers, shears, small pipe wrenches, calipers, screwdrivers, levels and many others, to conform to one's needs.

Many of these tools may be made by any blacksmith at small cost. It is a good plan to have a certain tool in your own tool-chest when occasion demands its use, and it is another good thing to know where to find a tool when you want it.

Most plant owners will furnish all the larger tools, but hesitate to supply small tools which are apt to become lost, strayed or stolen, especially in a plant where a number of workmen are employed, for not many will look after, or care for company tools as they will their own. Most plant owners will replace the tools you break or wear out on the job if approached in the right way.

In our engine room, on the wall are 3 tool or wrench boards which contain all the necessary engine wrenches and many other wrenches of various sizes and shapes. As soon as a repair job is finished all the tools are put in their respective places. Each of the 3 engineers has his own tool chest. I always encourage a fellow workman to make or buy his own tool chest, and buy one or more tools at a time as he is able (but do not "lift" someone else's), and in a short time a handy and useful kit of tools will be on hand if he is wise in making his selection. Many good tools may be procured at secondhand stores and pawn shops. C. E. N.

RUNAWAY ENGINES

I NEVER could see any good reason for requiring an engineer to stand right in front of a flywheel when stopping a runaway engine. Most engineers are brave enough to do this when necessary, but this is no argument in favor of making it necessary when there are so many ways of avoiding it.

It would seem that any man with enough business ability to be the owner of a steam plant would be able to see the wisdom of protecting his flywheels with automatic stops as he protects his boilers with safety valves. We all know, however, that a great many owners cannot be persuaded to use safety stops and it is up to us to recommend something that he will use. Of course, the throttle valve can often be swung around so that the handle is on the opposite side of the engine from the flywheel and this should usually be done, but in addition to this, I like to place a stop valve in the steam pipe just inside the engine room where the pipe enters, or at any point where it will be most convenient in case of emergency. If the pipe

is overhead, the valve can be fitted with a long stem or arranged with a cord so as to be operated from the floor.

In the case of a pumping plant I often install one of these extra valves in the pit and another above. I have seen the walls of 2 pump pits cave in, and while no one was buried and no steam pipes ruptured in either case I think it is just as well to have a convenient stop valve outside the pit.

Fred Boone.

ISOLATED PLANT COSTS

HAVING just gone through the tortures of working up a statement of cost for heating and lighting an institution, I was naturally interested in the article of S. J. T. in the May 15 issue of Practical Engineer.

The problem S. J. T. presents for discussion is easily solved, I think, in comparison with the problem of finding the separate cost of light and power where steam and electric plants were installed together, for the simple reason that the systems are so interwoven into one another that it would require a lot of costly measuring instruments and time-consuming record keeping to determine the operating cost of each separately.

To begin with S. J. T.'s problem, it is hard to see how such a plant can cost $150,000. One surely cannot figure cost of motors and machines driven by them as cost of plant.

By "cost of plant," we understand usually: boilers, pumps, engines, generators, switchboard, tanks, heaters, filters, separators, smokestack, piping, etc.; in other words, everything necessary for the production of heat or current or both.

The cost of the means of distribution is not a proper charge against the plant in my estimation, as one has to have those whether one buys heat, light and power or produces it in one's own plant, and the cost of motors using the current is all out of the question in this matter, as one might just as well call elevators part of the plant and figure them in the cost.

Now, S. J. T. states that in the plant he has in mind, 1200 tons of coal are burned a year, and as this coal is burned during the 6 winter months, 200 tons a month or 6⅔ tons a day are burned, and I fail to see how anybody can keep 6 firemen busy on that amount of coal. There are already 3 engineers on the job and 1 electrician, therefore no extra help will be required during the winter months to operate electric plant if installed. If 6 firemen are required during the winter months for some reason unknown to me, it is a certainty that no more than 3 will be required during summer months, as an output of 50,000 kw.-hr. a month does not call for such enormous coal consumption to keep more than one man on a shift more than comfortably busy.

S. J. T. mentions $30,000 as the cost of electric plant if installed and this should include cost of all changes and additions to heating plant made necessary by the installation of electric plant.

Now, I think we may figure on cost of generating our own current. For our present purpose it is immaterial what the cost of heating is; what we really want to know is, does it pay to generate your own current when you can buy 50,000 kw.-hr. for $900 or 1 kw.-hr. for 1.8 cents.

As I have already pointed out, no additional engineers will be required unless secondhand machinery is installed. One engineer on a shift is enough and they will be there all the year round anyway. This leaves only the 3 firemen to be added to the pay-roll at $2.25 each per day for 180 days, or $1215.

Allowing 48 lb. of steam per kw.-hr. and an evaporation of 8 lb. of water per lb. of coal, we get 6 lb. of coal per kw.-hr., or for 50,000 kw.-hr. we get 300,000 lb. of coal per month, or for the 6 months 900 tons of 2000 lb. each which at $2.25 would cost $2025.

Additional coal used during winter months would probably amount to 180 tons, figuring on returning to the heating system 80 per cent of heat of steam used by engines. This would amount to $405 more or a total of $2430 for coal.

Cost of oil, waste and packing S. J. T. figures at $20 a month, which seems a little high, but using this figure we get $240 per year.

Ash removal for 6 months at $20 a month, $120, and allowing $5 a month additional for winter months, this item amounts to $150.

The largest item would be interest and depreciation which at 10 per cent on $30,000 would be $3000, and add to this 1 per cent for maintenance and we have

Int. Dep. and Maint'ce	$3300.
Coal	2430
Labor	1215
Oil, waste, packing	240
Ash removal	150
	$7335

Let us add to this one oiler at $60 per month, or $720, and we have $8055 as a total of additional cost, and if $900 was paid per month for central station current, or $10,800 per year, then we have an apparent saving of $2745. Out of this, however, we have yet to pay for water during summer months when we cannot return it to the heating system, and figuring water at $1 per 1000 cu. ft. and 48 lb. per kw.-hr. and 50,000 kw.-hr. per month for 6 months we get roughly

$$\frac{50{,}000 \times 48 \times 6 \times 1}{60 \times 1000} = \$240.$$

Deducting this from our apparent saving of $2745 leaves us still $2505 which equals 8.33 per cent on the capital invested in addition to the 5 per cent already figured in the cost of current.

In addition to this it may be possible to produce more current if need be with the same equipment without additional cost except for coal. This seems altogether like a creditable showing of an isolated plant against this exceptionally low central station rate of 1.8 cents per kw.-hr.

Karl H. Muller.

FOR THE FIRST TIME in the history of American radium production, an express shipment of the precious metal for abroad was made recently by the Standard Chemical Co., of Pittsburgh. The shipment was the result of an order received in a cable message from Dr. Otto Brill, director of the radium research laboratory of the Standard Chemical Co., who is now in Vienna, Austria. Dr. Brill said that he had sold a quantity of radium to a Vienna institution and asked for the immediate shipment of 250 milligrams. This amount at the current price of the metal represents a value of $30,000.

Austria has generally been recognized as the headquarters of radium production in the world, and for America to be asked to supply radium for Austria, is not unlike sending "coals to New Castle" or "coke to Connellsville."

Successful Kinks From The Plant

For Saving Time, Work and Trouble

Engine Room Repairs

A short time ago a friend of mine who is a general repair man for a large machine shop received a call to a near-by village to repair an old engine and invited me to accompany him. After quite a troublesome journey through mud and slush we arrived at the scene of our labors. The engine was of an old type with gridiron steam valves and flat exhaust of the slide valve type. The engine was running when we arrived, or I might say was trying to run, and was certainly doing its best, but was having a hard time of it, as the exhaust could be heard about half a mile away. We looked it over and saw enough to satisfy us that it was about worn out and that strenuous remedies were necessary.

While we were looking around the engine room and waiting for a chance to shut down we ran across a box on a shelf covered thickly with dust and found upon taking it down that it was an indicator of an old but reliable make. Upon questioning the engineer, who, by the way, was one of the monkey wrench variety, we found that the indicator had not been used for years and that a former engineer, one of those

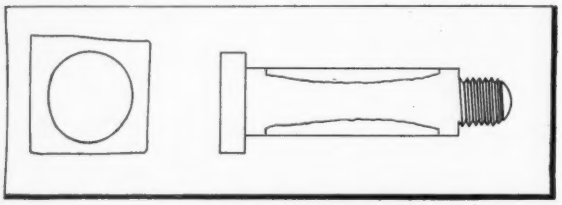


FIG. 1. WORN BLOCK AND PIN

"gol-darned book engineers" had used it and that he did not see any use for it anyway, as it only made a few marks on paper and didn't do any good.

The engine was tapped for an indicator and had 2 close nipples with angle valves attached and which the presiding genius had piped down through the floor and used as cylinder drips. My friend told him if he would get us some pieces of pipe to connect it up we would try and fool away a little of our spare time with it anyway.

We hitched the indicator up and took a few cards and found the engine had no compression at all and also that the admission was very late, which accounted for the loss in power. Lack of compression combined with late admission of course allowed the piston to come to the end of the stroke with quite a shock, and when steam was finally admitted whatever lost motion was in the boxes, etc., was suddenly taken up with a slam-bang. We also found that the load was very unequally distributed, the majority of it being on the crank end.

At noon we adjusted the taps, giving each one an equal amount of catch with the idea of evening up the load a little and advanced the eccentric in order to get better lead and get the steam in on time. We also took apart the connection from the rock shaft to the exhaust valve rod and found the pin to be 11/16 in. diameter and the hole in the block 1⅛ in. and worn oval, with the pin cut like a pair of corduroy pants. Was it any wonder there was no compression and that the engine was slightly noisy?

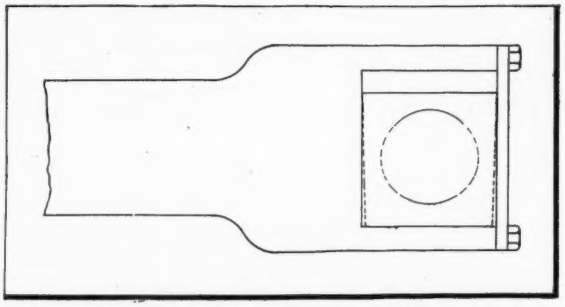


FIG. 2. ROCK SHAFT BLOCK SHOWING TENDENCY TO WEAR

Measurements were taken for a new block and pin, but right here an improvement was made. In place of having a square block with a round hole in it for the pin, a steel roller was substituted with a brass bushing for a bearing on the pin, a number of 3/16-in. holes were drilled in the surface of this roller to facilitate lubrication. The advantage of substituting this roller device lays in the fact that by using a square block the wear was centered on 2 sides, both of the hole and also the outside of the block, as shown in Fig. 2, while in the case of the roller the action of the rock shaft caused the roller to revolve, thus making a continuous wear all around the roller.

As it was inadvisable to shut down, the rest of the work was deferred till the following Sunday, when the roller bearing was substituted. When the steam chest

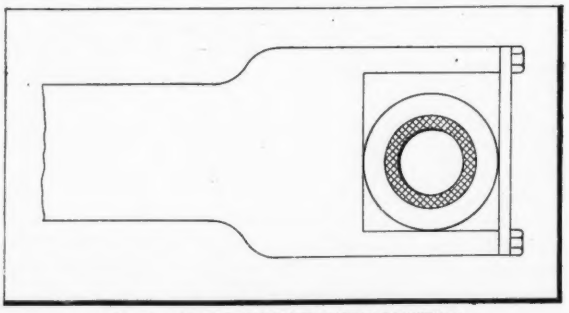


FIG. 3. STEEL ROLLER WITH BUSHING

covers were removed it was found that the flat gridiron steam valves were worn so loose as to allow them to slam back and forth endways in the steam chest and also could be twisted part way around. We removed these and drilled some 0.25-in. holes in the end, a piece of 5/16-in. flat steel was now procured and fastened on to the end of the valves by means of

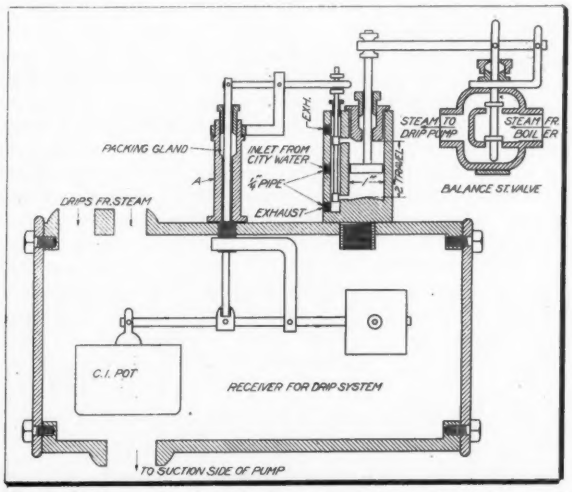
dowel pins, which were riveted down and then the whole thing filed down until they were a nice working fit, care being taken that the added piece did not project below the face of the valve, which, of course, would have prevented the valve from seating.

We now turned our attention to the links by which the steam valves were operated, which were also badly worn, and one of them unhooked altogether. We took them off and reamed them out and bushed them with some pieces of brass tubing, filing the pins to fit and putting in split cotter pins to keep them in place.

The valves were now adjusted for a little more lead and the cover replaced. The brasses were filed down and adjustments made and steam was now turned on and more cards taken and after adjusting the exhaust valves we got a splendid card and also a fairly good running engine, which was able to carry the load easily and was a little easier on the coal pile.

Automatic Pump Controller

DIAGRAM illustrates an improvement to a drip pump system. The receiver was fitted with a steam valve at A, the valve stem extending down and connecting to a float which raised the valve as the water rose in the receiver, thereby letting steam into the pump which emptied the water, putting it back in the boiler. As the water was lowered in the receiver the valve lowered till its edges just closed the valve, stopping the pump. The edges were not closed enough to seat the valve tight, with the result that



ARRANGEMENT OF VALVES TO MAINTAIN CONSTANT LEVEL IN RECEIVER TANK

the steam wire drew and cut the seat and disc. The pump would then run continuously and give us a job of repairing about every 2 weeks.

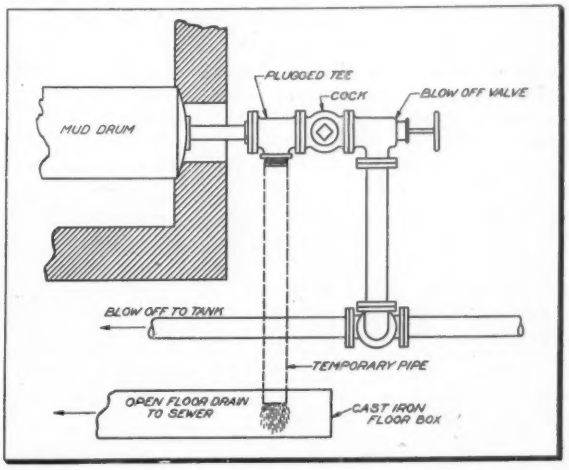
We then devised the water cylinder and attached the float to the pilot valve, the cylinder being connected to the city main. As the float rose it moved the pilot valve, admitting water under the small water piston, which then opened the steam valve to the pump. When the receiver was empty this action was reversed and the steam valve closed tightly. The pilot valve has 2 adjustable nuts that can be set apart so that the valve does not move till the receiver is nearly full.

This has been a perfect success and we have not needed any repairs to the steam valve since it was placed in service about 5 months ago. It uses about 2 cu. ft. of water in 24 hr. Pacific Coast.

Boiler Blowoff Lines

WE have 9 350-hp. Stirling boilers in our plant, arranged in a row on the third floor of the building. The boiler room had a cement floor laid on a concrete slat and if water was allowed to remain on the floor it would work its way through the slat and drip on the engines below. Having a puddle of water on the floor by your boiler was the same as asking for your walking ticket. When the boilers were washed or the turbine cleaner run through the tubes there was always a complaint about water until the following scheme was hit upon and it is well worth passing on as it has a great many good points.

There was a floor drain about 8 ft. behind the boilers which was connected to the sewer. This would carry away the water if we could get it back there. Each boiler was equipped with a cock and an angle blowoff valve, all the boilers connecting into the one blowoff line leading to tank.



BLOWOFF CONNECTION WITH PIPE FOR WASHING OUT BOILER

Referring to the sketch, a brass plugged tee was inserted between the cock and the boiler. When the boiler was to be washed the valve and cock would be closed and the brass plug in tee removed and a piece of pipe screwed in its place. When the boiler was washed down the water would run out this pipe to the floor drain. This was done when running the turbine cleaner and the scale would run out this pipe to the open drain where it could easily be picked up. This scheme keeps our blowoff pipes perfectly clean of all scale, etc., keeps all water off the floor and, as both the cock and blowoff valve are closed, it allows us to do what we please with the boiler without thinking of the blowoff from other boilers. O. C.

FIREBRICK IS EXTREMELY BRITTLE, a great deal more so than ordinary brick. When such bricks have to be shaped or cut to size, considerable loss by breakage usually occurs. They can be broken safely, however, if deep nicks on both sides and on the edges are first made. A still better way is to get an old handsaw and saw them to size. This will make nice smooth faces, but the set on the saw will be worn off quickly, and must be renewed. A hacksaw can be used for the purpose.—Pemberthy Engineer and Fireman.

THERE'S LIFE ALONE in duty done, and rest alone in striving.

—Whittier.

Questions Answered and For Answer

Expert Help When In Trouble. If You Want Quick Answer Enclose a Stamp

Open and Crossed Links

KINDLY let me know through the columns of Practical Engineer how I can tell the difference between opened and crossed style link motion without taking off steam chest cover, also what effect it would have on engine if open style should be put on crossed by mistake.

F. L. J.

A. The terms "open" and "crossed" rods apply to the positions which the eccentric rods occupy in relation to each other when the engine crank is on the crank-end center. In this position one of the eccentrics is slightly above the shaft and the other below. If in this position the rod from the upper eccentric is attached to the upper end of the link the rods are said to be open, Fig. 1.

If the rod of the upper eccentric is attached to the lower end of the link as shown in Fig. 2, the rods are crossed.

It is not necessary to look at the valve to determine whether the rods are open or crossed, for the rods themselves show. If the rods are open with the crank on

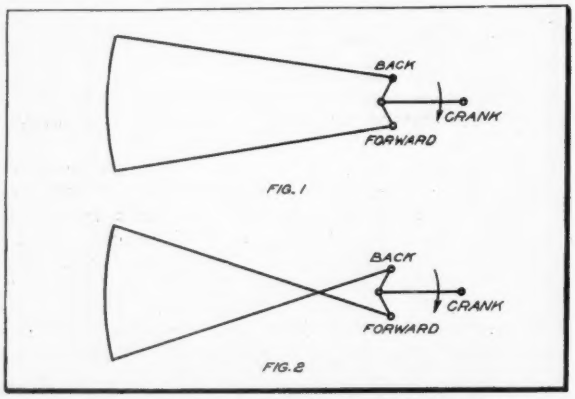


FIG. 1. OPEN ARRANGEMENT OF LINK MOTION
FIG. 2. CROSSED ARRANGEMENT OF LINKS

the crank-end center, they will be crossed when the crank is on the head-end center, as whichever way the link is connected the rods must cross through one half of each revolution of the shaft. If the rods should be changed from open to crossed accidentally or otherwise, the direction of the rotation of the engine would be reversed for the same position of the reversing lever. With open rods the lead increases as the link is hooked up and is greatest when the block is at the middle of the link, while the reverse is the case with crossed rods.

The valves of hoisting engines and locomotives used for yard work and switching should be set with crossed rods as the lack of lead when the link is hooked up will prevent the engine from running away because of a leaking throttle valve.

Alternator Frequency

ONE of my alternators is 100-kw., 2300-volt, 3-phase, 60-cycle, and runs 225 r.p.m. If I burn out a field coil, would it necessitate the cutting out of another coil of opposite polarity? (For example, if it was a north pole that burned out would I have to disconnect from the field coils circuit a south pole before I could run as stated? This machine has 32 poles, revolving field type.) What speed would this machine have to be run with 2 poles cut out to generate current at 2300 volts, 60 cycles, and could this machine be run in parallel with the other machine, which is 2300-volt, 60-cycle, 75-kw., under these conditions?

2. If a field coil is burned out but still in the circuit (not burned into any place), can it be rung through with a magneto?

3. Name a good paint to paint the field coils of an alternator, revolving field type, to keep the dust and dirt from sticking to the field coils. V. K. S.

A. It is not necessary to cut out a south pole because a north pole has burned out. If you operate with one pole out it will mean simply that that pole will carry half the magnetism that it would if the coil on it were active, and the 2 adjacent poles will carry ¾ of their normal current.

In your 32-pole machine this would mean that the total electromotive force would be cut down 1/32. To get 60 cycles per second from it you would have to run it at the same speed as before, but you would have to increase the field excitation in order to get the right voltage. You could probably run the machine all right in parallel with another one, but it would not be the best possible thing to do as you might find it difficult to regulate your voltage so as to keep the machines in step.

2. Burning out a field coil may mean either of 2 things: the burning off of a wire, or the burning of the insulation, so that a part or all of the coil is not carrying current. If the wire is burned off in one coil, all coils in series with it will take no current, then you must short-circuit the terminals of that coil in order to carry current to the poles. If the insulation is burned off, it will mean simply that the pole will not have its usual strength. In the first case a magneto would not ring through the coil. In the second case, it would, but if you measure the voltage drop over the different coils you would find it much less for the burned out coil than for those which are in good condition.

Several different paints may be used for field coils, either a good asphaltum enamel or any form of insulating varnish. If the coils do not run very hot you might use shellac, but if they warm up considerably, shellac is likely to warm up under the heat. A. L. R.

Exhaust Steam Drip

IF the head of a firm should ask you the necessity of an open drip between the cylinder and the open heater, how would you explain that waste of steam to him? A. A. W.

A. I should explain to him that there was a great deal of water coming through the exhaust pipe due to condensation of the steam, and, if the boiler should happen to prime over the water would come over in slugs, and without the drip connection would have to go over into the heater. As the exhaust pipe has a vertical rise of several feet, the water would lie in the bottom of the horizontal pipe until it reduced the area of the pipe enough to cause the exhaust steam to carry it along, when it would surge against the turns in the pipe causing a violent water hammer which would be liable to break the fittings. In shutting down the engine, if there was no drip, any water lying in the exhaust pipe might be drawn back into the cylinder, breaking it; or the pipe might become full during the time the engine was not running and the pipe would be broken on starting up due to water hammer. I would tell him that the open drip was unnecessary and wasteful of steam, and would ask him to buy a suitable drip trap or pump to take care of the condensation. J. C. Hawkins.

Refrigeration Problem

WE have a 4-ton (refrigerating capacity) Wizard compressor with double pipe type of condenser operated by a 12-hp. Fairbanks-Morse gas engine. This machine is now at our small packing plant where we have enough well water to run it direct, but we are contemplating moving this to the back of our retail shop uptown where the water supply is very doubtful. At the latter place we have an old well about 150 ft. from the building. We put a small engine and pump on this well a few days ago and managed to pump it down about 25 ft. in a few hours, but before we could get finished the big rains we have been having started in and the well filled up to the top while we were still running. This appears to be surface water, for although we have run the engine for 10 hr. straight, it has not lowered the water one inch, and it looks as though the well was simply draining the cellars around it and perhaps some of the low lying surface.

Supposing that after we could get a proper test we were to find the supply insufficient to run direct, and we wanted to operate 6 hr. per day, and used a cooling tower say 5 by 5 by 14, how much water would we require to start with, how much would be lost in evaporation and other unavoidable leakage in that time, and what would be the best way to pipe the water through the condenser compressor and gas engine?

To cool our retail meat box which is 6 by 8 we have figured with the Creamery Package Mfg. Co., on putting in 2 brine cylinders and pumping brine from tank in large box. Do the round, closed tanks give satisfaction or would an ordinary galvanized iron open brine tank do as well? This retail meat box would be used simply to handle piece meats and the quarters would be kept in the large cooler.

A. A reasonable allowance for your cooling tower would be a square foot of surface for each gallon of water cooled per minute, although you might, if you had a good location, with plenty of air circulation, be able to use a somewhat smaller tower.

You would need, with water at 55 deg. at the inlet to your condenser, and 95 deg. outlet, ¾ of a gallon of cooling water per minute per ton of refrigerating capacity, and if your inlet water was 80 deg., which would be more likely when using a cooling tower, you would need 2 gal. per minute per ton of refrigerating capacity.

As to the loss in the cooling tower, assuming that you can get a temperature of 75 deg., which would call for about 1½ gal. per ton per minute, and that you are running at 4 tons capacity, you would then need about 6 gal. a minute, or at 8⅓ lb. to the gallon, 50 lb.

This requires 20 heat units removed from each pound to reduce it from 95 to 75, or 1000 heat units a minute, which would call for the evaporation of about one pound of water, so that your loss would be about 2 per cent a minute under these conditions.

That would mean that you would have to add make-up water at the rate of 6 gal. every 50 min. It would probably pay you better to run a larger amount of water through your system, thus relieving the cooling tower of so much work, and cutting down the evaporation. Figuring 6 gal. for every 50 min., for a 6-hr. run, would call for an amount wasted during this run of 43 gal., and your 3000-gal. tank would be ample for your supply.

So far as cooling the meat box is concerned, we believe that the brine cylinders would be entirely satisfactory, and they have the advantage of keeping the strength of the brine practically constant. The galvanized open brine tank will, however, serve the same purpose and do quite as well, but should be kept covered.

To take care of the cooling of your gas engine cylinder, you would have to allow, on a rise of 10 deg., a matter of 3600 lb. an hour, or 60 lb. a minute. This would leave you 10 deg. rise for the condenser coils, and 60 lb. a minute should just about take care of it.

The piping should, of course, be from the tank, at the bottom of the cooling tower to the condenser coils, from there to the gas engine cylinder, and thence to the top of the cooling tower.

Horsepower of Engine

WILL you please tell me the easiest and quickest way of finding the horsepower of a 10 by 12 engine, not a stationary engine, but the same as a hoisting engine. 2. What is the best way to find the safe working pressure of different sizes of upright boilers?

B.

A. To ascertain the horsepower of an engine, the mean effective pressure and speed must be known. The engine constant of a 10 by 12 engine is 0.002,38. Multiply this by the revolutions per minute times mean effective pressure times 2, and you will have the horsepower. The mean effective pressure you can find by knowing the per cent cutoff and boiler pressure and referring to the Reference Tables of Practical Engineer, which contains a table of mean effective pressures. (As a rule, this size engine is rated at 50 hp.)

2. The safe working pressure of a boiler depends, first, on the pressure for which it was built; and secondly, on the physical condition of the boiler, depending on its age and use or rather misuse.

I infer that you have in mind an upright boiler of a hoisting outfit.

These boilers are, as a rule, built to carry not over 125 lb. pressure, except in special cases. Again, this class of boilers is subject generally to great misuse and neglect, and deterioration sets in fast. These boilers should be examined often, their condition is often found to be such that it is advisable to reduce the working pressure.

If you care to give us your conditions more definitely, we shall be glad to answer accordingly.

Problems For Discussion By Readers

What Would You Do If You Had These Conditions To Meet?

Reading Wattmeters

IN July 1 issue, page 661, J. J. asks for information regarding several sample dial settings.

These 4 samples cannot be from the same meter unless every hand is loose. Reading "A" assuming "1000" dial correct, it shows 800 as it is on 8, the next dial should be 8/10 of the way from one digit to the next, and as it is near 1 but not at the line we call it correct and annex 0 to our 800=0800.

As this hand is near 1, the next higher dial should be 1/10 past some figure, and being just by 9, we now have 90,800. The next one is 9/10 past 9 and the correct reading is 990,800. This 9 shows that the next hand should be 9/10 past a figure, and as in sample it is about 1/10 past 0, it is wrong and should be set or "read" back of 0, or 9/10 past 9 and called 9, giving our full reading as 9,990,800.

"B" starts off with a 900; the next hand is correct at 9/10 past 9, giving 9900; the next hand should be 9/10 past 1 instead of about 2/10 past 2; it is evidently misplaced and should read 9/10 past 1, or 19,900.

The next dial (1,000,000) is wrong; standing as it does near 6, or say 8/10 past 5, while it should be about 2/10 past 6 and the reading so far is 619,900. The next hand should be 6/10 past 8 and is shown about 8/10, reading 8 correctly now, but ready to make trouble by passing 9 too soon. The reading complete for "B" is 8,619,900.

These last 2 hands that now show 86 will soon be 87 and then 88, then instead of the last hand staying below 9 to give 89, it will go over and give 99, raising the reading by 1,000,000 instead of 100,000 as it should.

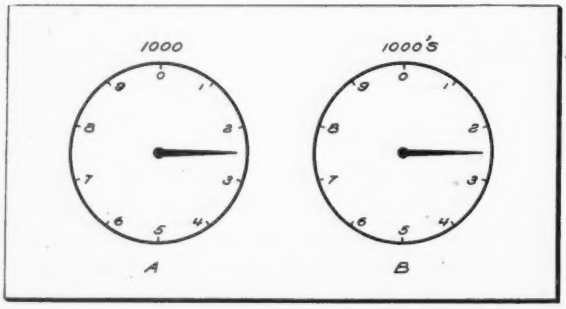


FIG. 1. 'S DISTINCTION ON DIALS

Reading "C" is 200, the next hand wrong side of 5 should be 2/10 past 5 (assuming we move it to the nearest correct place), our reading is now 5200. The next hand should be 5/10 past 3 and is shown slow and will not pass 4 till the lower hand (10,000 dial) is way past 0. The reading is 35,200. The next hand is slow; it should be 3½/10 past 8, reading 835,200. The next highest is correct at 8/10 past 0, reading 0,835,-200.

"D" is 300, 3/10 past 9, correct, and 9300, 9/10 past 3, or 39,300, 4/10 past 0 (slow), or 039,300, 1/10 past 4 (slow—is not at 4 yet); reading should be 4,039,300. You will note that the same hands are not "out," in each reading, showing these cannot be from same meter.

I cannot tell J. I. how to bill his customer as the multiplier on meter is not given.

Each dial gives only the figure shown above it when it has made one full revolution and the next higher dial has passed a figure, or has counted the trip and let the lower hand start afresh.

If these figures shown over dials had ('s) after them, then each unit on dial would count full number, then A=200, B=2000.

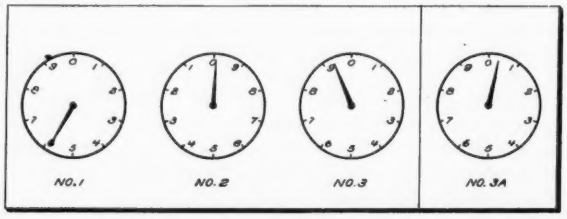


FIG. 2. READINGS WHERE ERRORS ARE APT TO OCCUR

If J. I. had meter reading of say 4,602,300 one month and 5,276,900 next month, he would charge 5,276,900—4,602,300 (total has been paid month by month)=674,600 (increase to be paid for).

If meter reads direct and in watt-hours and power is say 10 cents per 1000 kw. hr., he would do thus: 674,600÷1000=674.6 kw. hr. At 10c, 674.6=674.6× $0.10=$67.46 for the month's power.

Any other price than 10c must be worked out, of course.

Each dial shows how many full revolutions the next lower dial has traveled.

And the distance between any 2 figures on a dial equals the full trip on a lower one.

Hence if a dial stood halfway between 4 and 5 the lower one should be halfway around, or on 5.

If the lower dial was on 9 or past it and very near 0 the higher one should be very close to a figure, but not there yet, as the lower one has some distance to travel to complete its trip.

If both are so close as to be doubtful, as in dials 1 and 2, then look at 3, which shows a little over 9, hence 2 is under 0 and counts 9 and 1 is proved to be 9/10 past 5 and still reads 5, or 599.

If No. 3 appears as in 3a, then it reads 0, has made a full turn and is past 0 and reads 0; hence 1 must

count as 6, or the complete reading is 600. Reading 1 wrong in the first case would give 699 instead of 599. If 2 were read wrong in the same case it would be 609 or 509, just as you wished. Always find the position as given; 3—9, 2—9/10, past a figure or 9=99. One must be 9/10 past a figure or 9/10 past 5. No mistake can ever occur if the hands are thus checked from lowest one up. Charles M. Green.

REPLYING to the question of J. I. in July 1 issue, in reading wattmeters, the one essential thing to be remembered is that each dial must be read in conjunction with the one to the right of it. No hand is to be considered as having passed any figures on the dial unless the hand on the next lower dial has passed 0. This is self-evident from the fact that one revolution on a given dial equals one division on the next higher—so that no division can be completed without the next lower hand having completed one rotation and passed the 0 mark. It is therefore convenient to read wattmeters from the right to the left.

To analyze, the readings of the examples you submitted:

In A, the right-hand dial which we will call No. 5, reads 8. Dial No. 4 reads between 0 and 1, and it cannot read 1 until dial 5 has passed 0. So far we have ....08.

Dial 3 reads between 9 and 0. We know it has passed 9 because dial 4 has passed 0. So we have ....908.

Dial 2 reads between 9 and 0. It has not yet passed 0 for dial 3 has not yet passed 0. We have ....9908.

Dial 1 appears to be between 0 and 1. As dial 2 has not yet passed 0, however, we know that dial 1 has not passed 0, so we have for complete reading 9,990,800 watt-hr.

In example B, dial 5 reads 9. We have .....9. Dial 4 appears to read between 9 and 0. It has not yet passed 0 for dial 5 has not passed 0. We have then ....99. Dial 3 appears to read 2. However, dial 4 has not yet passed 0 so we must call this reading 1 and we have ....199. Dial 2 appears to be between 5 and 6, it is very near 6 and we know that it really has passed 6 from the fact that dial 3 has passed 0. We have .....6199. Dial 1 appears to read between 8 and 9. It will not, however, read 9 until dial 2 has passed 0. So our total reading is 8,619,900 watt-hr.

In example C, dial 5 reads 2. We have then .....2. Dial 4 reads nearly 5, and we know that it must be past 5 from the fact that dial 5 has passed 0. So we have ....52. Dial 3 appears to be between 3 and 4. We know it has passed 3 because dial 4 has passed 0. So we have .....352. Dial 2 reads between 8 and 9. We know it has passed 8 because dial 3 has passed 0. We have....8352. Dial 1 reads between 0 and 1. It will, however, not read 1 until dial 2 has passed 0, so our completed reading is 0,835,200 watt-hr.

Example D, dial 5 reads 3. We have .....3. Dial 4 reads between 9 and 10 or 9 and 0; we know it really has passed 9 because dial 5 has passed 0. So we have .....93. Dial 3 reads nearly 4, but it will not read 4 until dial 4 has passed 0. So we have ....393. Dial 2 reads between 0 and 1. It has passed 0 because dial 3 has passed 0. Dial 1 should read between 4 and 5, as dial 2 has just passed 0. The total reading then is 40,393.

If, as you say, the previous reading was 373, the consumption would be 393 — 373 = 20 kw.-hr. The customer should be charged for 20 kw.-hr. If your rate were 12 c. per kw.-hr., the amount would be $2.40, etc.

To figure a customer's bill on the straight consumption rate, multiply the difference between the present reading and the previous reading by the rate per kw.-hr. In dials such as examples A, B and C, it is customary to neglect the last dial which reads in watt-hours, when rendering a bill. Thus, for practical purposes, A, B and C read respectively, 9990, 8619 and 835 kw.-hr. If A were this month's reading and B were last month's reading at 12 c. per kw.-hr., the bill would be (9990 — 8619) × $0.12 or $164.52.

If C were this month's reading and A were last month's, our consumption would be

$$\begin{array}{r} 0835 \\ 9990 \\ \hline 845 \end{array} \qquad 845 \text{ kw.-hr.}$$

For the purposes of our subtraction we would have to consider that during the month the dial 1 had finished its revolution and started over again, so that it could be considered as reading 10,835 instead of 835.

Sometimes you will find meters marked with a constant. For instance, in a certain type of meter you will find the legend "Multiply by 2" marked on the dial face. This means that the net consumption obtained by subtracting the previous reading from the present reading is to be multiplied by 2 to give the true reading. Thus in your example D above—if the meter were marked "multiply by 2," your consumption would be 40 kw.-hr., instead of 20. If the meter has a constant of 10 or multiple of 10, as 100, 1000, etc., the 5th dial should be read and not neglected as stated above, as in this case the value of the divisions on the last dial would be quite large.

You will note that if hands were not displaced one should always read the smaller of the 2 numbers between which the hand is located. If the pointer is on a figure, the next lower dial will determine whether it or the next lower value is to be taken. When hands are displaced, however, it is sometimes necessary to assume that the hand has passed a given number even though it has apparently not quite reached it, if the next lower hand so indicates.

Gasoline Engine Trouble

ANSWERING the inquiry of E. L. M. in the July 15 issue, as to the defects in his engine, his letter does not convey a very complete description of the engine, but some things are evident at once. The clearance space above the piston is entirely too large, resulting in low compression. As a remedy, fasten filler blocks to the top of the piston, adding enough until the compression reaches 75 lb. by gage. In the writer's opinion this will increase the power and give what he wants.

As to the matter of exhaust and inlet ports, figure their area, and the amount of gases passing the area should be such as to give a velocity below 5000 a minute. This is all the information I can give without a more detailed description of the engine, its speed and the details of its construction. The ratio of bore to stroke is not good; stroke should be longer for such a bore. J. C. Miller.

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COOPERATION IN ENGINEERING

It happens not infrequently that there is a lack of cooperation between the operating engineer and the consulting engineer. This is unfortunate because each can learn from the other important specific facts and broad general principles. Particularly is it true that the younger consulting engineer would do well to study carefully and weigh the suggestions of the operating engineer. He should permanently dismiss the idea that he possesses a superior intelligence and freely discuss with the operating engineer the equipment and arrangement of plant details, because the operating engineer has, if he is the right sort, gathered about him a fund of information, much of which can be acquired only by extended operating experience which can and should be reflected in the completed installation.

But, on the other hand, the operating engineer should not lose sight of the fact that the consulting engineer, if he is of the right sort, has acquired facts, general experience and power of analysis that comparatively few operating engineers have an opportunity to gain. Each class of engineers has its opportunities to learn along somewhat differing lines and close cooperation between them should lead to the highest development in engineering work.

The consulting engineer, with his mind fixed on the broad generality of the design, is quite apt to overlook the importance of some details which are really of consequence to the easy and proper manipulation of the installation, and here is one point where the operating engineer's experience can and should be worked into the final plant scheme.

It frequently occurs that a number of items in a power plant, which are not necessarily essential to its operation but which, nevertheless, are proper and reduce the care and worry of the operating engineer, can be worked into the consulting engineer's specification, expenditures for which the plant owner might not approve at a later date. Judicious discussion of these items with the consulting engineer generally gets the operator what he wants and mutual benefit results to all concerned.

The consulting engineer may have good judgment in the selection of boilers best adapted to the particular service, but it is easy for him to lose sight of the fact it might be highly desirable to specify a separate cold water line from some high pressure pump, for efficient boiler washing. He may have had wide experience in illumination yet may overlook the great convenience to the engineer, of running a line of electric conduit, provided with plenty of plug and lamp outlet, to various parts of the frame of a large engine or pump.

The operating engineer in a running plant is frequently looked to by the owner to give advice in improvements or added capacity. His advice may be good, but the purchasing agent or owner, in the hands of a smooth salesman is quite likely not to get what is wanted or if perchance the proper thing is gotten a greater price is paid than would have been had the matter been referred to a consulting engineer who had made careful

specifications meeting the requirements and by virtue of experience was able to get the different bidders to the lowest consistent price, and to advise as to the most advantageous proposals.

Broad minded engineers, in whatever capacity, appreciate and invite intelligent suggestions and reviewing of their prospective plans and specifications but carping criticism is not relished by anyone. Let the keynote in all engineering work be—cordial cooperation.

NEWS NOTES

THE PERMIT WAS ISSUED recently for the erection of the power house of the St. Petersburg (Fla.) Electric Light and Power Co. The building will be erected in the western part of the city.

THE NORTHERN UTILITIES CO. is to expend $50,000 in a new power plant to be erected at Dixon, Ia. It is estimated that $100,000 high tension wires have been strung this year from Dixon as a center.

THE AMERICAN PULLEY CO. has moved its New York branch from 203 Lafayette Street into more commodious quarters at the corner of Grande and Greene Streets. At the new address is carried a complete stock of American belt pulleys. Orders will be received for reels, spools, beams, sash pulleys, and pressed steel shapes.

MEMBERS OF THE COUNCIL of Aberdeen, Wash., have pledged themselves to the establishment of a municipal lighting plant in response to a petition of taxpayers. The city is paying $500 a month for light, which is thought to be too high. The council has also gone on record as favoring the building of a reservoir as a reserve addition to the water system.

THE NEWFANE (N. Y.) Basket Manufacturing Co. and the Newfane Electric Co. have entered into an agreement whereby the former concern will erect a power house on the site of its recently burned factory, and the latter company will furnish the machinery, lease the power house and water rights and sell to the basket factory about ¼ of the 300-hp. developed.

AT KALAMAZOO, MICH., ground for the new municipal power house, authorized by the city council a year ago and contracts for which have all been finally completed, was broken recently by the Coddington Engineering Company of Illinois. The building is to cost $29,100 and with the entire equipment $115,000. The sum of $25,000 additional for lights has been voted and provided for.

COMMONWEALTH POWER CO. officials have announced that the power plant at Albion, Mich., recently destroyed by lightning with a loss of $100,000, will be rebuilt at once. Albion is lightless, as far as electricity is concerned. Many local factories have installed gasoline engines, but whole departments have been closed to await the resumption of the electric service.

IT IS STATED that the South Carolina Railway, Light and Power Co. is contemplating the erection of a $100,000 steam generating station to be used as an auxiliary to its hydro-electric plant at Gaston Shoals. An additional hydro-electric station will be constructed at Palmer Shoals, 6 miles above the present plant. The new plant will generate 16,000 hp. and cost about $1,000,000. The Gaston Shoals plant now in operation generates 12,000 hp. Extensions and additions to trackage and equipment at Spartanburg are now being made.

A BUILDING PERMIT has been issued for a $28,000 addition to the San Joaquin Light and Power Company's fine $250,000 steam plant on the outskirts of Bakersfield, Cal. This addition will be 140 by 144 ft., and with the installation of new machinery will cost something like $40,000. Improvements at the Kern River Canyon plant call for the installation of a 5000-hp. turbine engine.

GEORGIA POWER CO., which has erected at the cost of $65,000, a substation, or reducing plant in Lindale, has planned for a larger improvement, and when this is done, the Lindale substation will be completed at a cost of over $200,000. Arrangements are now being made for the establishment of its lines into Rome, where they will connect with the lines of the Tennessee Co., which the Georgia Power Co. has recently purchased.

NEBRASKA PORTLAND CEMENT CO., with headquarters at Omaha and a plant at Superior, will enter the water power field on the Republican River. Plans for carrying out the provisions of its approved application have been completed following a conference with the state irrigation board. The company's first development will be modest. A total of 300 cubic second feet of water will be taken from the river and will be converted into power at a plant to be erected near Table Rock. The total of the first venture will amount to about $175,000, but later entrance on a much larger scale may be made after the first proposition has demonstrated its worth.

AT A MEETING of the business men of Ava, Mo., recently, a thorough discussion was had of the electric lighting proposition and of the project to construct a dam for generating hydro-electric power.

It is proposed to construct a dam across Bryant Creek, below Vera Cruz and the junction of Bryant and North Fork. The cost is to be something like $350,000, to be constructed and in operation about June 1, 1916.

The proposed contractor expects to induce factories of all kinds to locate in and around Ava to use the white oak timber for manufacturing articles, such as hoe, ax, hammer and all sorts of handles, chair rounds, rockers, chair posts, etc., neck yokes, wagon spokes, insulators, etc., in fact everything that is manufactured from this timber to be made in these factories, which will be operated by this electric current, and the money obtained from this source to create the profits expected.

AT ONEONTA, N. Y., all insurance adjustments of the Elmore Milling Co. have been made and E. W. Elmore recently confirmed the announcement previously made tentatively that a new mill will be erected. It will be of solid brick walls, 3 stories in height, 80 by 90 ft., and will be erected upon the site formerly occupied by the elevator. It will be given a fireproof roof and upon the second and third floors will be installed all the latest and most improved milling machinery for grinding corn and oats, the company having decided to discontinue the grinding of buckwheat.

Perhaps the most notable improvement in the mill as contrasted with the old one is that the first floor will be utilized as a working floor with all the machinery for grinding upon the floors above. Upon the first floor will be automatic weighing devices of the most approved pattern and the manufactured product from the floors above will be brought to the proper place on the first floor and the expense of handling it and placing it in packages ready for shipment will be reduced to the minimum. Every implement and device for economizing in the work on the first floor will be secured and it is believed that the plan will be far superior in every way.

CONNECTICUT CONVENTION OF N. A. S. E.

Annual Gathering Held at Meriden

THOUGH the big coming event of the national convention of the N. A. S. E., which is scheduled to occur in the neighboring city of Springfield, in September, visibly cast its shadow before, and made difficult the work of the managing committees, yet it must be said that a gratifying measure of success was attained at the eighteenth annual convention of the Connecticut State Association, which was held in Meriden on June 26, 27 and 28. The convention assembled in the Town Hall, where the facilities for exhibition purposes, as well as for the regular work of the convention, were ample.

The opening exercises included a cordial address of welcome by Mayor D. J. Donovan and appropriate response by national vice-president, James R. Coe, and F. N. Hastings, chairman of the committee of arrangements. Following the formal exercises interest centered in the auditorium of the building where the usual exhibition of power plant machinery and supplies took place. Although the display was not so elaborate as on some former occasions, yet the showing made was as creditable as it was interesting

On Friday evening, the delegates and supply men took trolleys to Meffert's Terrace, a pleasant summer garden, where a banquet was spread which took the form of a Dutch supper. Informality and jollity ruled at the feast, so that all present were keyed up to the enjoyment of the lively program that followed. This program, which was admirably conducted by Frank N. Hastings, the chief engineer of the Wilcox & White Co., consisted of songs and recitations by professional entertainers among the supply men; speeches impromptu and interesting, from delegates and supply men; a particularly good sleight-of-hand act by "Billy" (Rainbow) Martel of The Peerless Rubber Co. of New York and the presentation of a "loving cup" in the shape of a large oil can to Frank N. Buckley, a member of The Commercial Engineers.

Most notable among the speeches was that of Walter Damon, superintendent of the Springfield Electric Light Co., and chairman of the committee of arrangements for the coming national convention of the N. A. S. E. Mr. Damon gave in some detail the plans already decided on for the entertainment of the visit-

ENGINEERS IN ATTENDANCE AT THE CONNECTICUT CONVENTION

while the genial representatives of the various manufacturing and supply houses were indefatigable in their efforts to interest and instruct the visitors by explanation and illustration of the goods, and by liberal distribution of useful souvenirs. The hall and booths were simply but effectively decorated and presented a harmonious and pleasing appearance. Each day, while the exhibition continued, a pleasing program of musical selections was given on the stage and contributed much to the enjoyment of those present.

A noteworthy feature of the convention was the presence of "The Ladies Auxiliary," which occupied the largest booth in the exhibition hall, and evinced much enterprise and energy in accomplishing their purpose of raising funds for pensioning engineers of the organization who may become disabled in the performance of their duties. Besides purchasing refreshments and various articles of the ladies' handiwork which were on sale at the booth, nearly every exhibitor and visitor wore conspicuously the "tag" that showed he had contributed to the pension fund.

ors during convention week, and from the data given it is evident that a royal welcome will be extended to the delegates and that a unique record for convention entertainments will be established. The plans involve an expenditure of about $4000.

After the banquet party adjourned and trolleyed back to town, they re-assembled at the Auditorium, where the exhibiton had been held, and an informal but jolly good time was enjoyed till a late hour of the night.

On Saturday morning the members of the convention assembled for the regular business session, which was presided over by President Thomas J. Phillips of Hartford, and considerable routine business was transacted. The convention of 1914 will be held at Bridgeport on the last Friday and Saturday of June.

The following officers were elected to manage the affairs of the State Association for the ensuing year: President, B. J. Reynolds, of New Haven; vice-president, Charles M. Dowd, of Bridgeport; secretary and treasurer, John Galvin, of Meriden; conductor, James

McGee, of Hartford; door-keeper, Samuel Austin, of Norwich; state deputy, R. J. Green, of Hartford; trustees, Thomas J. Phillips of Hartford, W. H. Goodrich of Bridgewater and Charles Ostrander of New Haven. It was voted to present the name of F. N. Hastings of Meriden to the national convention as door-keeper for the national body. Mr. Hastings was chairman of the committee of arrangements for the convention, his helpers being A. J. Lane, A. D. Sanford and Herman Oefinger.

The feature of the convention of greatest interest to visitors was, of course, the exhibition of power-plant machinery and supplies, and in this department there was a good representation of the popular and reliable concerns that provide all things needed in order to enable the engineer to bring and keep his plant up to date in equipment and efficiency. The following are deserving of mention:

The Economy Fuse & Mfg. Co., of Chicago, made an attractive display of engine room goods, making a special feature of their Renewable Fuse.

L. Sonneborn & Sons, Inc., of New York, were noticeable with an elaborate showing of specialties in modern methods of lubrication.

The American Steam Gauge and Valve Mfg. Co., of Boston, were represented with an impressive and much admired exhibit of their popular line of valves, gauges, indicators and other specialties. A. W. Hobbs and W. H. Nickerson explained the merits of the goods.

The Garlock Packing Co. showed a fine line of packings adapted to all purposes of the power plant. Their representative, Mr. Buckley, demonstrated the exceptional qualities of the company's products.

C. S. Mersick & Co., of New Haven, displayed a line of oil cups, gauge glasses, cutting tools and general mill and engine-room supplies. W. F. Doolittle and H. N. Glynn attended.

The Travelers Indemnity Co., of Hartford, exhibited some remains from explosions, which furnished an effective object lesson on the value of accident insurance. The exhibit was in charge of A. G. Smith.

The Walter G. Ruggles Co. exhibited power plant specialties, particularly featuring Martin shaking grates, White Star oil filters, R. K. exhaust head and Vance steam trap. J. J. Monahan was in charge.

The H. W. Johns-Manville Co., New York, made a good showing of J-M Sea Ring and Permanite sheet packing adapted to serve all needs in the power plant requiring safe and durable packing. C. H. Tower and H. T. Lyman were in charge of the exhibit.

The Economy Lubricating Co., of Boston, displayed a line of lubricating greases and oil cups, the merits of which were explained by James F. McCurdy.

The Botfield Furnace Specialties Co. showed fire brick and cements, emphasizing specially "The Adamant cement." C. C. Phillips explained the goods.

The Southern Engineer had a booth which was in charge of Louis Warren.

The Welding Company, of Springfield, exhibited a number of samples showing notable results from their special processes. A. C. Ford was in charge.

The Ladies Auxiliary had an elaborate booth, from which they dispersed encouragement and refreshment to the visiting engineers. Mrs. Mary Hughes presided.

The Ashton Valve Co., of Boston, was in evidence with an elaborate presentation of catalogs and special literature descriptive of their reliable products.

The American Metal Hose Co., of Waterbury, Conn., showed an interesting and varied assortment of durable hose and couplings. The merits of the goods were well explained by A. W. Hughes.

The Eagle Supply Co., of Boston, exhibited Perolin, a German preparation for preserving boilers. J. A. Morehouse was the representative.

The Crane Valve Co., of Bridgeport, had an excellent display, showing a variety of their well known products, which were explained by Joseph Keating.

Power was represented by Jack Armour.

The Albany Lubricating Co. displayed lubricating grease and a variety of oil cups. W. D. Naughton was in charge.

The Mason Regulator Co., of Boston, had a large and effective display of reducing valves. Their booth was in charge of Frank A. Morrison and F. T. Abell.

The United States Graphite Co., of Saginaw, had an interesting and instructive exhibit of graphite for lubricating purposes. A special feature was a display of boiler graphite. The booth was in charge of W. G. Thompson, W. A. Coles and A. L. McLean.

The Ashcroft Valve Co., The Consolidated Valve Co., The Hancock Inspirator Co., and the Hayden & Derby Mfg. Co. united in an effective display of up-to-date products.

National Engineer was represented by Charles Ceilley.

The Roto Company, of Hartford, was in evidence with an array of their appliances for cleaning boiler tubes.

The Dearborn Chemical Co. made a good display of results obtained from the use of their preparations in removing scale from boilers.

The Pratt & Cady Co., of Hartford, made an elaborate display of valves, showing as a special feature their asbestos disc globe valve, the removable feature of which makes it of exceptional interest to engineers. An interesting illustration was made of the asbestos in various forms of preparation for final places on the disc. The attendants in charge were W. A. Hancock and J. J. McKenna.

The Peerless Rubber Mfg. Co., of New York, made a fine display of their special lines in rubber goods, emphasizing especially their Rainbow packing, Peerless piston and valve rod packing, Eclipse tubular gasket, and Perfected construction of hose. The merits of the goods were well explained by W. G. Mueller and "Billy" (Rainbow) Martell.

Greene, Tweed & Co., of New York, made an effective display of their celebrated Palmetto packing.

The Lunkenheimer Co., of Cincinnati, exhibited valves in great variety, and of exceptionally valuable qualities, also a good line of engineering specialties. W. A. Reynolds and W. A. Beals were there with the goods.

The Philadelphia Grease Mfg. Co. had on exhibition a full line of their lubricating greases, put up in convenient and attractive packages. Their booth was managed by T. Addison Collens and F. Waldo Gordon.

The New York Belting and Packing Co. made a creditable display of their specialties in belting and packing goods.

Jenkins Bros., of New York and Boston, brought out the sterling advantages of Jenkins valve specialties in a fine exhibit under the management of Ray Stiles.

The Evans Mill Supply Co., of Boston, made a fine display of steam specialties, including the Squires steam traps, pumps and reducing valves. A steam trap in actual operation attracted much attention. F. H. and F. S. Evans were in charge of the exhibit.

Nightingale & Childs Co., of Boston, exhibited pipe covering, asbestos slate, and Burnite, a preparation for fire-proof roofing and siding. A. Shutte explained the goods.

The Keystone Lubricating Co., of Philadelphia, made its customary imposing display of oils and greases for power plant and motor purposes.

McLeod & Henry Co., of Troy, New York, had on view an interesting line of steel mixture products. The genial and popular manager, John Foote, directed the exhibit.

The Durabla Mfg. Co., of New York, made a fine showing of sheet packing and Durabla discs, which through a new process of manufacture are credited with exceptional wearing qualities.

The McClave-Brooks Co., of Scranton, Pa., had an exhibit of McClave grates that proved of much interest to visiting engineers.

The V. D. Anderson Co., from their Boston office, made a good display of valves and steam traps. They were represented by L. A. and F. M. Couch.

Clement Restein Co., of Philadelphia, exhibited Belmont packings and a line of mechanical rubber goods. A. H. Foster was in charge.

The Quaker City Rubber Co., of Philadelphia, made a fine showing of packings of approved merit. Special stress was laid on Ebonite sheet packing, which, it is confidently claimed, will hold any joint tight, regardless of pressure or vibration. E. Howe was in charge.

The Hartford Mill Supply Co. had a varied and well arranged display of steam specialties for the power plant in charge of George Seeley and H. E. Woodman.

The Engineering Supply Co., of Philadelphia, made an attractive display of power plant specialties, prominent among which were Lord's boiler compounds and Ohio cylinder grease. L. Hallbauer was the representative.

NEW ENGLAND N. A. S. A.

First Session at Lawrence, Mass, July 10-12

THE convention of the N. A. S. E., which was held in Lawrence, Mass., was notable for 2 reasons. In the first place it was the initial assembly of the members of the N. A. S. E. as a New England organization, and in the next place, coming as it did, during "Merchants Week" when the city had put on its best attire, and had culled out a holiday, and had strewn many pleasures in the path of its visitors, it had an exceptionally festive environment that contributed largely to its success. The convention, however, was not dependent for success on fortuitous circumstances; the intelligence, zeal and well directed effort which the committee of arrangements put into the preliminary work insured its success from the start.

Convention proceedings began at noon of Thursday, July 10, with the formal opening of the exhibition of engineering goods and supplies which had been arranged by the Commerical Engineers. The exhibition and exercises took place in the large drill room of the State Armory which had been made available by the courtesy and generosity of the militia authorities, and which had been profusely and tastefully decorated for the occasion. The hall with its long aisles of uniformly constructed and handsomely decorated booths; its extensive and elaborate display of engine room accessories; and its numerous working models of up to date engineering apparatus gave the impression of being the scene of an important mechanical exhibition rather than an adjunct to an engineers' annual convention.

As President Ashton of the Commerical Engineers, stated in his opening address, the leading manufacturers of engineering specialties from all parts of the country not only advertised in the engineering papers but at the convention "they were there with the goods." After the exercises which included, besides the address of President Ashton, remarks by Asa M. Day of Northampton, and music by the Engineers' Orchestra, the exhibition was thrown open to visitors, and remained in busy session until 10 o'clock p. m. During the evening a smoke-talk and buffet-lunch were features of the hospitality of the local engineers at their hall on Common street.

On Friday morning the official opening of the Convention proper took place at the City Hall at 10:30 o'clock. The convention was called to order by Ralph N. Howard, chairman of the committee of arrangements. He closed his remarks by introducing Mayor M. A. Scanlon, who then welcomed the delegates in so cordial and earnest a manner as to evoke enthusiastic plaudets. Following the address of Mayor Scanlon there were speeches by E. H. Kearney of Boston, Past National President; F. N. Chandler, President of the Lawrence Chamber of Commerce; Past National President T. N. Kelsey of Lowell; Past State President J. H. Sumner of Cambridge; Past National President P. H. Hogan; W. McComb, of the Chamber of Commerce, and National Vice-President J. R. Coe of New York City. The speeches were interspersed with musical selections excellently rendered by the Engineers' Orchestra. At 12 o'clock the Convention adjourned to meet at N. A. S. E. Hall, Common street, at 1:30.

At the afternoon session reports of officers and committees were received and a large amount of routine business was transacted. It was voted to hold the convention of next year in July at Providence, R. I. The following officers were elected and subsequently installed in office: Asa M. Day of Northampton, president; Thomas A. Ray of Cambridge, vice-president; J. J. Quinn of Holyoke, secretary; Walter H. Damon of Springfield re-elected treasurer; M. M. Childs of Providence, R. I., door keeper, and Andrew Waite of Portland, Me., conductor.

In the evening the delegates, exhibitors, and visiting engineers were entertained with a varied and highly enjoyable program given at a smoker in City Hall. The large auditorium of the building was filled and every number on the program was warmly applauded. C. D. Allen, chairman of the committee of arrangements of the Commercial Engineers presided and added to the enjoyment of those present by his manner in presenting those who took part in the platform exercises. The program included speeches by Mayor Scanlon, J. R. Coe, B. L. Ames, and T. N. Kelsey: songs by D. Noonan, W. Murphy and Frank Coppinger: recitations by Jack Armour, and bag-pipe selections with comic monologue by J. Meehan. After the smoker, festivities were continued at N. A. S. E. Hall and kept up till a late hour.

On Saturday at 8:30 a. m. the delegates were given an automobile tour about the city which included a visit to all the leading points of interest. Following the ride there was an illustrated lecture on turbines.

At 11 o'clock special cars conveyed the members of the convention to Canobic Lake where they enjoyed a ball game in which the Commercial Engineers were victorious over the stationary men, and an excellent dinner was partaken of.

Commercial Engineers Meeting

INCIDENTAL to the convention, the New England Association of Commercial Engineers held their second annual meeting. There was a large attendance and a number of changes including an increase of the annual assessment were discussed and enacted. The following officers were elected: President, Bradford L. Ames, treasurer of The Climax Smoke Preventing Co. of Boston; vice-president, W. C. Barnes, treasurer of the Jarvis Engineering Co., of Boston; treasurer, H. E. Stone, manager of the Pittsburgh Piping and Equipment Co. of Boston; directors A. C. Ashton of the Ashton Valve Co. Boston, John E. Statt of New Bedford, and F. P. Upson of Hartford, Conn. An elegant traveling bag and toilet-set was presented to the retiring president, Albert C. Ashton.

The exhibition of power plant machinery and supplies by the New England Association of Commercial Engineers was one of the most complete and interesting yet given and drew a deservedly large and appreciative attendance of visitors.

The concerns participating in the exhibition follow:

The Lawrence Machine Co. had a display of centrifugal pumps, with attached engines. A Lawrence centrifugal feed pump with Curtis turbine connection, and open so as to show interior construction was an exhibit of exceptional interest. Frank B. Kilburn explained the advantages of the company's product.

Wm. R. Winn, of Springfield, Mass., New England Agent for N. B. O. packing made a good showing of various lines of packings, also leather dressing, stick belt dressing and soaps of their own manufacture. J. B. Harrington and F. B. Driscoll were in charge.

The American Steam Guage & Valve Mfg. Co. made their customary exhibit of valves and gauges. Their American Thompson Improved Indicator was given special prominence. A. W. Hobbs represented the company.

McLeod & Henry Co. of "Steel Mixture" fame displayed their mixture for boiler settings. The exhibit was in charge of John H. Foote, manager, and A. W. Pettie, New England representative.

The Ashcroft Manufacturing Co. and associate concerns displayed an attractive line of valves and inspirators, emphasizing particularly "the Consolidated safety valve." Nelson J. Allaben was in charge.

Office of B. L. Ames, Boston exhibited the "Climax smoke preventor" whose merits have been demonstrated for years, also the Monarch rear end flue blower, for horizontal tubular boilers, and a soot remover for water tube boilers. Mr. Ames and Mr. Gibbons were in charge.

The Geo. W. Knowlton Rubber Co., of Boston, made an effective display of G. W. K. packing adapted to the various needs of the power plant.

L. S. Couch, of Boston, attracted attention with a fine showing of the Anderson steam traps and copper floats.

Chas. A. G. Winther & Co., of Boston, had an interesting exhibit in which the Simplex seatless blowoff valve was the prominent feature. Mr. Winther and Mr. Tripp were in charge.

The Crandall Packing Co., of Boston, had an exhibit of packings and Crandall's boiler compound. The merits of the goods were explained by George H. Kenrick and E. A. Hare.

J. Henry Blanchard, of Boston, representing Artesian Well & Supply Co., displayed Kennicott Water Softener, Water Filters and Water Weighers, France Metallic Packing, N. E. Fire Cement and Zines Lightning Soot Destroyer. Mr. Blanchard was in charge of the exhibit.

The Eagle Oil Supply Co., of Boston, had a display which demonstrated the efficacy of their Perolin German boiler metal treatment. J. A. Morehouse was in charge of the display.

The Griscom Russell Co., of New York City, made an excellent exhibit of feed water heaters and steam engines, surface condensers and steam and oil separators, and other steam specialties. William A. Evans the New England manager was in charge, assisted by J. H. McIntosh.

The Philadelphia Grease Mfg. Co. made an attractive showing of lubricating greases. T. Addison Collins was in charge, assisted by Fred W. Blanchard and D. J. Leahan.

The Cancos Mfg. Co., of Philadelphia, manufacturers of Cancos packing were represented by John J. Sullivan, with a display of their Cancos packing and Cancos metal polish.

The Wickes Boiler Co., of Saginaw, Mich., showed a model of the Wickes vertical water tube boiler in actual operation which was managed by E. F. Baker.

Practical Engineer exhibited sample copies and premiums and distributed literature. The booth was in charge of Joshua O'Leary, general subscription representative for New England.

The Watts Regulator Co., of Lawrence, Mass., manufacturer of steam specialties exhibited pipe flanging, forged steel valves, Boyd turbine valve seat and Rice boiler energizer and smoke abater. Geo. Gray was in charge.

The H. W. Johns-Mannville Co., of New York, displayed a varied and extensive exhibit of their specialties in packings. F. R. Haile had charge of the demonstration.

The Curry Bros. Oil Co., of Boston, displayed a line of packing and mechanical rubber goods. A special exhibit was made of their new steel boiler broom and famous Bangabout ash cans. M. L. Curry was in charge.

The Lunkenheimer Co., of Cincinnati, was represented by the Boston office force with a fine display of valve specialties.

The Garlock Packing Co. made a display of their standard packings. Mr. Allan was manager with P. L. Rogers in charge.

The Bride Grimes & Co., of Lawrence, displayed products of the National Tube Co. H. L. Patterson and J. L. Bride were in charge.

The Autoforce Ventilating Co. illustrated the merits of its ventilating system with working models. The display was interestingly explained by W. N. Goddard, who was managing the exhibit.

The American Tool & Machine Co., of Boston, was prominent among exhibitors with a goodly display of special shaft-hangers and couplings, also the combined oil-separator and waste washing machine. A centrifugal oil separator for extracting oil from chips for machine shops was also shown. The exhibit was in charge of Edw. J. Eichler.

Calven H. Currier Co., of Boston, was in evidence with a line of second hand machinery, including generators, motors, pumps, engines and boilers, also belting and pulleys. F. D. Grantham was in charge.

The Lunsden and Van Stone Co., manufacturing and erecting engineers of Boston, exhibited power plant fittings and Durabla packing and gage glasses. H. E. Gross was in charge.

The Penn Flexible Metallic Tubing Co. made a demonstration of its product which attracted much attention. John Whalen represented the company.

A. M. Byers, of Pittsburgh, Pa., exhibited a line of piping and couplings illustrating the advantages of his special process of welding and construction. G. Frank Uhler was manager.

The United States Graphite Co. had an exhibit of Mexican graphite product adapted to various uses. A display of scale removed from boilers was a feature of the exhibit.

The International Engineering Works, Ltd., of Boston, presented steam boilers and MacDonald Shaking Grates. Prominence was given to the Robb Scotch Boiler. D. W. Robb, Jr. was representative.

The Mason Regulator Co., of Boston, was in line with its standard products. F. T. Abell and F. S. Morrison were in charge.

The Ashton Valve Co. had a display which included pop safety and relief valves, pressure and vacuum gages, recording gages, engine room clocks, also bubbling drinking fountains. Harry H. Ashton was in charge assisted by Columbus Dill and Mr. Hampson.

Jenkins Bros. made a showing of valves, gages and packings. Ray Stiles of the Boston office was in charge.

Greene, Tweed & Co., of New York, had a display of Palmetto and Manhattan packing. Leland J. Van de Wall explained the goods.

A Registration Booth where the interests of delegates and exhibitors were cared for was efficiently managed by Past National Presidents P. H. Hogan and H. A. Stone, and local secretary, A. W. Varley.

The W. J. Hyland Mfg. Co., of Springfield, made a display of valves, faucets and fountain bubblers. A feature of special interest was a line of Bashlin valves with seat rings changeable under pressure. F. C. Green and Charles A. Southwick were in charge of the exhibit.

The National Engineer booth was in charge of C. F. Ceilley.

Southern Engineer was represented by L. L. Warren and C. J. Madison.

The Welding Co., of Boston, made its usual extensive exhibit of metals showing the results of autogenous process of welding. J. G. Armstrong was in charge.

The Gardner Grate Co., of Boston, had a decidedly novel exhibit in the form of the eye guard shield and reflector for use in protecting the eyes of the operators when renewing glass water gages.

The Lagonda Mfg. Co., of Springfield, Ohio, exhibited a varied assortment of strainers and tube cleaners. Harold Atlas was in charge.

The Patterson Lubricating Co., of Boston, had on view a large line of lubricants and engineers supplies. Wm. J. Patterson was in charge of the exhibit.

The Evans Mill Supply Co., of Boston, had an interesting exhibit, a special feature of which was a demonstration of the Squires Improved Steam Trap under working conditions. Frank H. Evans and W. P. Evans were in charge.

The Keystone Lubricating Co. made a display of lubricants in packages of assorted sizes.

The Fred W. Goldthwait Co., of Boston, showed the possibilities of Betson Plastic fire brick by models of varied construction. Goldthwait was in charge.

The Jones Under-Feed Stoker Co. occupied a booth from which explanatory literature was presented to visitors.

The Albany Lubricating Co. displayed a large line of lubricating greases also a special line of brass oil feeders adapted to various requirements of the power plant.

The Callisons Brass Foundry, of Lawrence, had a display of artistic brass mouldings including medallion portraits, and-irons and various art-pieces. Albert Berkett was in charge.

The Chicago Pnuematic Tool Co. displayed an assortment of electric and pnuematic drills which proved attractive and interesting to many visitors. Some specimens of diminutive and movable electric hand grinders excited much favorable comment.

Arthur D. Little, Inc., chemists and engineers of Boston, made an exhibition consisting of the various instruments and apparatus employed in making efficiency tests. Perry Barker was demonstrator.

The Monarch Valve Co., of Boston, showed a good variety of valves, the qualities and special merits of which were explained by W. D. Hasley.

Power was represented by Jack Armour and N. C. Robbins.

A. W. Chesterton Co., of Boston, exhibited the Sonder glass, the Fireman's Favorite tube scraper, Russo and Vaporite sheet-packing and combination pump packing. H. D. Raymond, Arthur Parker and T. T. Walsh were in charge.

The Robinson Hardware Co., of Lawrence, made a display of engineers tools and supplies.

WISCONSIN ENGINEERS IN CONVENTION

Thirteenth Annual Meeting Held at Milwaukee July 10 to 13

DELEGATES from various parts of the State were delighted when they reached Milwaukee to find that the weather-man had changed his tactics and ordered the temperature lowered to suit the pleasure of the visiting engineers. All meeting of the convention, as well as the exhibit, were held in the American House, the arrangement being the most convenient possible for the occasion.

Formal opening of the convention was in the Exhibit Hall when the chairman of the local arrangement committee, F. C. Ruck, introduced W. S. Osborne, president of the C. S. E. A., who invited the engineers and all citizens of Milwaukee to examine the exhibits, criticize the apparatus, suggest improvements in details of design, and otherwise profit by their attendance at the exhibit hall.

Following this opening, the baseball trophy which was won by the ball team of the C. S. E. A. last year was presented to the president by the manager of the engineers' team, John Wickert. The entertainment committee then proceeded to put the trophy into use by serving punch in it to those in attendance.

The convention proper was opened Friday morning by an introductory address by F. C. Ruck, presenting to the visiting engineers Hon. G. A. Bading, Mayor of Milwaukee, who assured the non-residents of the city a most hearty welcome to Milwaukee, and spoke at considerable length upon the value of a State License for engineers in preference to a city license, which has worked so favorably in Milwaukee, his objection to the city license being that it creates more or less of a wall around the city, preventing those in other parts of the State from coming into Milwaukee and engaging as engineers without considerable difficulty, which in many cases keeps them away.

John F. McGrath, National President of the N. A. S. E. then gave an address, setting forth to the engineers the value of pride and confidence in their profession, and the necessity of equipping themselves with knowledge in power plant affairs by continual study, research and experiment, making themselves qualified to hold the best positions that can be had in the steam engineering profession.

Chas. Cullen, Secretary of the C. S. E. A., was then introduced, and gave a short address, setting forth the aims and objects of the Central States Exhibitors' Ass'n., which has, in the past 4 yr., been associated closely with the state associations.

"The N. A. S. E." was the subject upon which F. W. Raven, national secretary, addressed the convention. Mr. Raven stated briefly the history of the organization, telling of its growth up to the present time and the increase during the past year, in detail. He also explained the principal objects of the organization, setting forth the benefits to be derived by its members, both from a financial and educational standpoint, as well as the social enjoyment which is had by the members.

"The National Engineer" was the title of the address by John W. Lane, its editor. This magazine is the official organ of the association and has been the means of bringing to each member news in regard to the organization, and technical information relative to the design and operation of power plants.

Formal opening of the convention then took place, and J. H. Mistele, state president, gave his address, setting forth the work which has been done during the past year in the educational line, and spoke of the responsibility which rests upon chief engineers of all plants stating that he is continually responsible for the operation of the plant and seldom leaves the plant without giving instruction where he may be found at a moment's notice.

After the appointment of committees, the convention adjourned until 1:30 in the afternoon, when J. L. White of Milwaukee read a paper on the "Operating Engineer as a Political Factor." He spoke of the class of men who are frequently found soliciting clients, claiming to be consulting engineers, but who have lacked in practical experience, and do not, in fact, have the necessary qualifications to supervise the operation or design of a power plant. He also spoke of the high qualification of a man who has worked from the coal pile to the engine room, and how his advice to owners and superintendents is so frequently ignored, giving as his reasons for this, the lack, on the part of the operating engineer, of skill in persuading his employer and proving to him that his knowledge is correct and his advice best in the plant. Mr. White solicits the assistance of all engineers in secur-

ing license legislation in the state, as such a license will not only greatly assist the competent engineers to secure and hold the best positions, but is a safeguard to the public against destructive boiler explosions.

In Panama

FRIDAY evening, at Miller's Hall, John W. Lane delivered an illustrated lecture upon engineering at the Panama Canal. Nearly 100 slides were shown during this lecture, giving in detail much of the mechanical equipment, and showing the various gates, locks, and cities which are along the Panama Canal. Photographs were taken by the speaker and his companion, Alfred Johnson, who visited the Canal Zone last fall.

Following the lecture of the evening, the floor was cleared for a dance which was enjoyed by about 300 ladies and gentlemen who were in attendance at the lecture.

Saturday morning, Prof. Robt. Bauer of Marquette University, spoke on the subject of "Engine Room Chemistry," describing the value of coal analysis and explaining the method of making approximate analysis, aided by instruments which he displayed. He spoke also of the chemistry which an engineer should know, the preparation necessary to study engine room chemistry, and the equipment essential for a coal test.

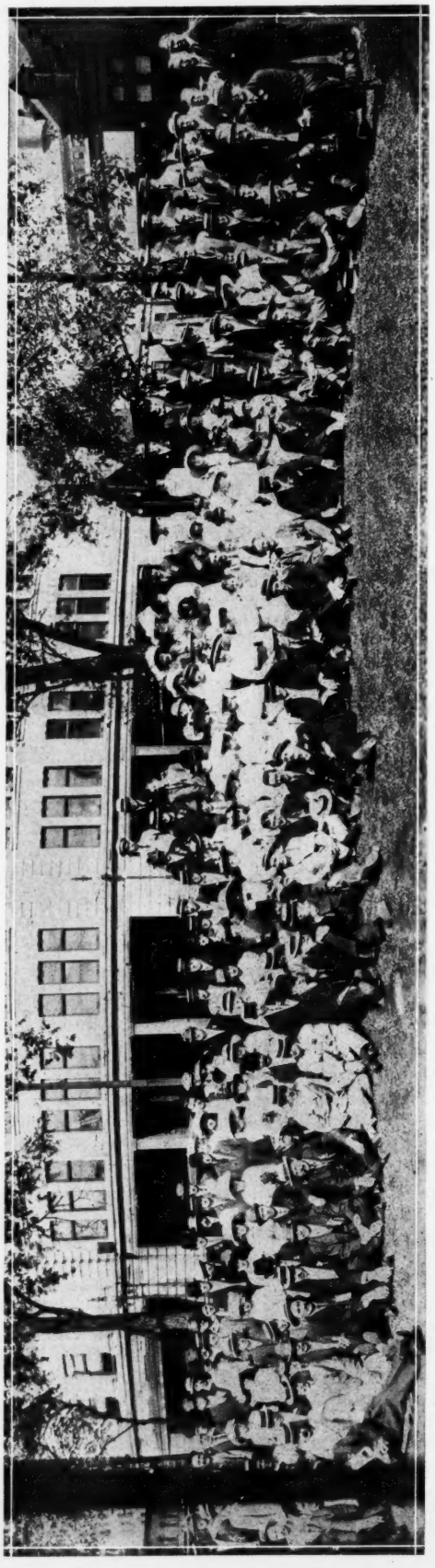
A paper was then read by Wm. Classman, entitled "Utilization of Exhaust Steam."

He took up the subject in a detailed way speaking of selection of prime movers, proportioning of exhaust mains, oil separators, measurement of low pressure, introduction of live steam, drainage, heating water by exhaust steam, cooking, and then described the installation at the Pabst brewery as follows:

"Some time in 1902 or 1903 I devised a system such as is now installed and later found that a similar system was about the same time proposed for the Pschor Brewery in Munich, Germany.

"We made the necessary tests as to consumption of steam, and found that each brew took from 12,000 to 16,000 lb. of steam in the kettle. When equipping the brewery with a new power plant, an extra unit of 300-kw. capacity, driven by a vertical noncondensing engine to run with 40 lb. back pressure was installed. This engine supplies the brew kettles with exhaust steam, fed through a 10-inch header to the 6 kettles, each kettle having a 6-inch supply valve, dividing into 8 2-inch branches, which enter the steam bottom at 8 different places. This arrangement was made because it was impossible to enter the steam space with a large connection (the exhaust pipe leading to the middle of the header and feeding to both sides). The exhaust pipe of this engine is also connected to the receivers of 2 compound noncondensing engines, in order to compensate when more or less steam is used than is furnished by the 300 kw. unit. If less steam is used, it gives to the low-pressure cylinder of the compound engine, and if more is used the low-pressure cylinder of this engine is robbed of that much.

"Should the back pressure of the 300-kw. unit drop too low, a Foster reducing valve will admit the missing steam from the high-pressure line. The exhaust line leading to the brew kettles is also equipped with a relief valve, which will permit the steam to blow into the low-pressure exhaust line should it suddenly rise too high, until the pressure is reduced. The installation works very well and is used about 6 months out of 12. During the cold weather, and at moderate temperatures, when the malt house is running there is no use for it, as all the exhaust steam is used anyway. Sometimes it is used at day time only. The saving may be figured as follows:



DELEGATES AND FRIENDS AT THE WISCONSIN CONVENTION

There are usually 18 to 20 brews made in 24 hr.; taking 14,000 lb. per brew, and 20 brews, we require about 280,000 lb. of steam, or 11,500 lb. an hour. The steam consumption of this unit is about 50 lb. per hp.-hr., we require therefore 230 hp. If you take this power from the compound noncondensing engine we get a saving of 4893 lb. an hour, or 117,432 lb. a day, this, at an evaporation of one to nine, would be a net saving of 13,000 lb. of coal, at $3.25 per ton, equals $21 a day."

New Officers

OFFICERS elected for the coming year are: President, A. Gunderson, Sheboygan; vice-pres., Fred Ruck, Milwaukee; sec., Robert Fenn, Sheboygan; treas., John Novotny, Madison; conductor, George Dueno, Manitowoc; doorkeeper, John Jones, Kenosha; state deputy, John Wickert, Milwaukee. The convention city for next year was not decided upon.

The afternoon was spent in a trip of inspection to Schlitz brewery in chartered cars, where State Deputy John Wickert, took great pleasure in showing the visitors through his immense plant.

At 9 o'clock that evening President Osborne of the C. S. E. A., called the smoker to order and in an appropriate speech introduced the toast master of the evening National Secretary Fred Raven.

Toasts were responded to by many prominent engineers, supplymen and ladies and the hall was vacated at a late hour. There were some 400 present to enjoy the evening.

The baseball game between the C. S. E. A. and the engineers at Lincoln Grove, Layton Park, Sunday morning resulted in a score of 11 to 9 in favor of the engineers.

The Exhibit

THE Central States Exhibitors' Ass'n., was founded 4 yr. ago in Wisconsin, so that to many of the exhibitors, coming to Wisconsin was like coming home. There were, therefore, a large number of exhibitors who occupied booths in a banquet hall of the hotel which was tastefully decorated with oil paintings and made a beautiful place for the exhibits. Following are the firms represented at the convention:

Milwaukee Boiler Co. was represented by I. M. Bean, who distributed literature describing the good qualities of the Milwaukee boiler.

Chase Bros. Co., Milwaukee, exhibited the Falls automatic frictionless engine stop, Wilcox self-seating gasket, Dunham's steam traps, Nichols' Perfection pump valve, and other engine room specialties. Those who explained the exhibit were J. H. Raymaker, J. M. Robb, H. E. Chase, C. L. Chase, and F. S. Palmer.

Power was represented by A. R. Maujer and H. R. Anness.

Crandall Packing Co. displayed, in a most attractive way, various packings and gaskets made by this company. These included metallic, fibrous, sheet, Lip, diagonal packing, Diamond SSS, Wilpaco, and other well known styles of sheet and rod packing. Fred Brunner was on hand to give advice upon the best methods and styles of packing.

Milwaukee Reliance Boiler Co. distributed literature describing heaters, gas producers, boilers, tanks, etc. J. E. Sharp, D. A. Forsythe and Wm. C. Zacharias were the representatives in charge of the booth.

United States Graphite Co. displayed the various products made from Mexican graphite, starting with the ore and including water proof, cup, cable and graphited wood greases and boiler graphite. J. W. Eviston and W. G. Thompson were the graphite experts.

Jenkins Bros. had a complete line of valves and rubber specialties on exhibit, including pump discs for all purposes, check valves, whistle valves, gate, globe and Y valves, Graber Safety water column stop, and Jenarco packing. J. C. Beckerleg explained the good points of these products.

Greene, Tweed & Co. displayed Palmetto and Manhattan packings for high pressure, superheated steam and air. Also emphasizing the rod packings made by this company. A. J. Richardson was the representative.

American Steam Gauge & Valve Mfg. Co. displayed the American dead weight tester, American Thompson Improved Indicator with outside spring, indicating and recording pressure gages, planimeters, whistles, pop safety valves, etc. Chas. C. Kilander was in charge of the exhibit.

Dearborn Chemical Co., with E. T. Ward and Fred S. Hickey as representatives, distributed literature pertaining to Dearborn feed-water treatment and oils, as well as souvenirs as a reminder of the convention.

The V. D. Anderson Co., through its representative, Chas. H. Fiske, displayed the Model "D" steam trap in sections, parts, and models.

I. W. Downing, Milwaukee, displayed a number of power plant specialties, including the Pittsburgh Safety Water Column, Hines high and low pressure trap, Hill pump valve, the Haines steam trap, boiler graphite, greases, oil filters, etc.

Garlock Packing Co. exhibited high-pressure sheet packing, wire insertion brown sheet, oil proof sheet, red sheet, as well as various forms of gaskets for all purposes, pump valves for hot and cold water and air, metallic rod packing, etc. J. P. Landreth, A. F. Sheldon and Arthur E. Johnson were in charge of the booth.

Richardson-Phenix Co., Milwaukee, explained the value of its oil pumps, filters, lubricating pipe fittings, sight flow indicators, etc. J. Wm. Peterson, J. P. Quam and A. B. Furch were the attendants at the booth.

Viscosity Oil Co., Chicago, displayed various grades of lubricating oils, Creole greases, stick belt dressing, metal polish, oil pumps, etc. Geo. Abbott and T. F. Gute were the representatives.

The Home Rubber Co., through its local agent, Otto E. Schmidt Belting & Rubber Co., displayed N. B. O., O. I. M. and Martell packings, sheet packings, automobile tires, etc. John Terrill and O. E. Schmidt were the representatives.

The Lunkenheimer Co., represented by Harry A. Burdorf, exhibited brass specialties, including lubricating devices, iron body valves, whistles, etc.

The C. E. Squires Co. had a working model of the Squires trap in operation during the convention, the good points of which were brought out by J. G. Boyer.

The White Star Refining Co. manufactures Detroit greases, and Silas Cook was on hand to tell what they will do toward reducing friction.

Monarch Boiler Arch Co., Milwaukee, displayed a model arch for a horizontal return-tubular boiler, the operation and advantages of which were explained by I. M. Bean.

Nordberg Mfg. Co., represented by J. L. Hayes, distributed literature on Nordberg engines, including the Corliss, uniflow, pumping engines and compressors.

Hawk-Eye Compound Co. distributed literature in regard to the treatment of boiler feed waters with Hawk-Eye Compound, being represented by R. M. Rochfort and Theo. Brommenschenkel.

The Wm. Powell Co., represented by Chas. Cullen, displayed Powell valves, especially the "White Star" and Cyclone Blowoff, also oil and grease cups, hydrostatic lubricators, whistles, etc.

Wadham's Oil Co., Milwaukee, decorated its booth with bottles of oils, cans of grease, and grease cups. Geo. W. Hale, Geo. C. Sullivan and Venturi Callahan were in attendance at the booth.

The Schaeffer & Budenberg Mfg. Co., represented by A. H. Reuter, pointed out the excellent qualities of its tachometers, indicating and recording pressure gages; thermometers, draft gages, steam engine indicators, mercury gages, pyrometers, recording thermometers and engine registers.

H. W. Johns-Manville Co. displayed on a number of swinging panels the various asbestos products, including insulations for heat and electricity, packing, roofing, electrical supplies, pipe covering, etc. R. E. Jordan and E. H. Pierce were in charge of the exhibit.

National Engineer was represented by John W. Lane and Edward J. Kuechenmeister.

S. F. Freeman & Sons Co., Racine, exhibited the model of a boiler in cross section and gave out literature describing the qualities of these steam generators. Wm. T. Doyle was in charge of the booth.

General Welding Co., Milwaukee, displayed samples of welding work done on rods, straps, gasoline engine cylinders, castings, gear wheels, copper, etc., by means of the autogenous system. A. W. Collins and Eric Pfieger explained the difficulties and advantages of this class of work.

Independent Oil and Grease Co., of Milwaukee, was represented by Mr. Kenenberg.

International Acheson Graphite Co. exhibited cans of Oildag, Gredag, Acquidag and Graphcoat, a new product used on auto tires and gaskets to keep them from sticking. W. W. Acheson was on hand to explain the uses of the different products.

Practical Engineer was represented by R. E. Turner.

McCoy-Nolan Heater and Supply Co., Milwaukee, displayed a line of engineers' supplies, including rubber goods, hose, packings, graphite, etc.

Albany Lubricating Co. exhibited a line of Albany greases, and grease cups, the booth being in charge of A. J. Olson, President of the "Don't Worry Club."

Julius Andrae & Sons Co., Milwaukee, displayed a line of electrical supplies, including motors, fans, light guards, Bryan-Marsh Incandescent Mazda lamps, circuit breakers, etc. E. L. Thoms and J. D. Holt were in charge.

The Vilter Mfg. Co. pointed out the good features of its ammonia fittings, valves and special pipes, Mr. Vilter being in charge of the booth.

N. A. Olson Chemical Mfg. Co. displayed samples of its boiler compound and compound feeders, being represented by N. A. Olson and Geo. E. Kuehn.

Ashton Valve Co. was represented by Harry Aller.

Federal Asbestos Co., Milwaukee, demonstrated how its insulating material can be used on boilers and steam pipes. Also displayed nonpareil high pressure blocks, asbestos cement, roofing, etc. Arthur Etzius and Chas. Dieringer were the demonstrators.

H. P. Spalding, Milwaukee, exhibited the Vulcan soot cleaner, Shear-Klean sidewise shearing and rocking grate, Eclipse smoke indicator, Blonck boiler efficiency meters, Hayes gas analysis instrument, Eddy smoke recorder, and distributed literature on the Swift stoker.

Arrow Boiler Compound Co. was represented by E. M. Swindler, who distributed literature pertaining to feed-water treatment.

Keystone Lubricating Co. made the way easy with its greases, oils and grease cups, Jas. Conlan and A. S. Bennett being the lubricators.

Osborne Valve and Joint Co. displayed samples and cross sections of the protected seat valves known as "No Kut" valves, used on steam, air, ammonia and hydraulic lines. W. S. Osborne was the representative.

Power Apparatus in Shop and Market

New Ideas In Making, Buying and Selling

RECORDING DIFFERENTIAL PRESSURE GAGES

A COMPREHENSIVE new line of recording differential pressure gages has been developed by the Bristol Co. of Waterbury, Conn., some of which have been in successful service continuously since the preliminary models were first sent out in 1908, and the design and construction of the line of these instruments now being placed on the market is based on results obtained in actual service during the last 4 yr. These recording differential pressure gages are designed for use in connection with venturi meters, pitot tubes, orifices, combinations of orifices and pitot tubes, etc., and thereby to record velocities and volumes of air, gas, steam, water and other liquids flowing through mains and pipes. These recorders may also be used to advantage for recording differences and variations of liquid level in steam boilers, pressure tanks, filter beds, process kettles, etc.

FIG. 1. ASSEMBLED VIEW OF THE BRISTOL DIFFERENTIAL RECORDING GAGE

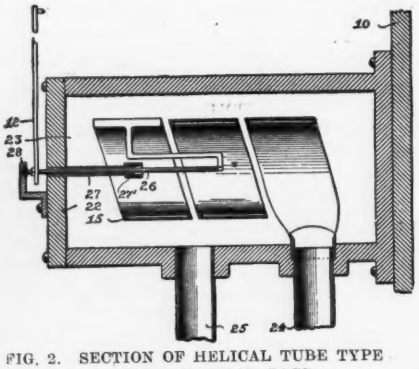


FIG. 2. SECTION OF HELICAL TUBE TYPE DIFFERENTIAL GAGE

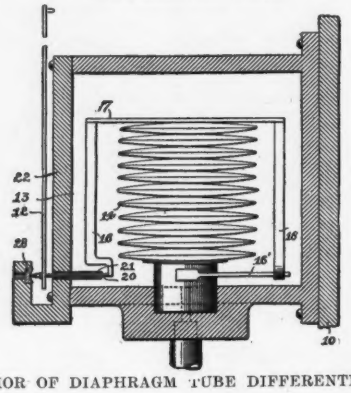


FIG. 3. INTERIOR OF DIAPHRAGM TUBE DIFFERENTIAL GAGE

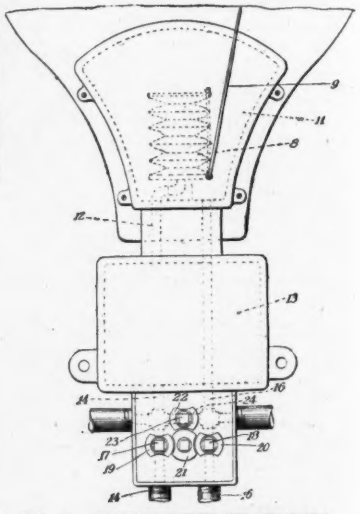


FIG. 4. CONNECTIONS OF BRISTOL DIAPHRAGM TYPE GAGE

The fundamental principle employed in the construction of this differential pressure gage is that one pressure is applied to the inside of the operating tube while the other is applied to the outside of the same pressure tube within a closed casing. In order to record the movement of the pressure tube it becomes necessary to transmit its motion to the outside of the pressure tube casing. As the differential pressure to be recorded is usually small as compared with the static pressure, the operative force is correspondingly small, and it is quite evident that it will be impractical to use a stuffing box around a shaft passing through a pressure casing on account of the friction which would be produced. To avoid the use of a stuffing box a unique frictionless sealing device is employed as described in detail below.

Figure 1 shows the exterior of one type of these recorders; Fig. 2 shows part of the interior construction of the spring tube type differential recorder. Pressure tube 15 is of the hollow helical type. One of the pressures, the difference between which is to be recorded, is applied to the interior of this tube through the pipe 24 and the other pressure is applied to the exterior of this tube through the pipe 25. The pressure tube 15 is entirely enclosed in the pressure-tight casing 22. Movement of the pressure tube will be in proportion to the difference between these 2 pressures, and this motion is transmitted to the recording pen arm 12, outside of the pressure casing, by means

of small shaft 26 through the long tubular sleeve 27. The capillary action of oil or other liquid between the sleeve and shaft makes this patented joint both frictionless and pressure tight.

In Fig. 3, 22 is the pressure-tight casing enclosing the diaphragm pressure tube 14, and in a similar way one pressure communicates with the interior and the other pressure with the exterior of this tube, and its motion is transmitted by means of the rotating shaft through the sleeve 21 to the recording pen arm 12. The length of this sleeve is many times the diameter of the shaft passing through it, differentiating it from an ordinary bearing.

This patented device permits of the recording of extremely small differences between the pressure existing respectively inside and outside of the pressure tube. It has been found that the simple frictionless

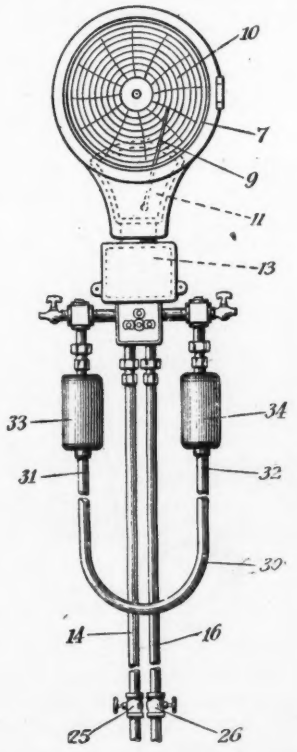


FIG. 5. SAFETY DEVICE FOR USE WITH DIFFERENTIAL GAGES

sealing sleeve through which the pen arm shaft passes does not produce appreciable resistance to the rotation of the shaft, and at the same time capillary attraction and adhesion prevent leakage of even high pressures from the pressure casing.

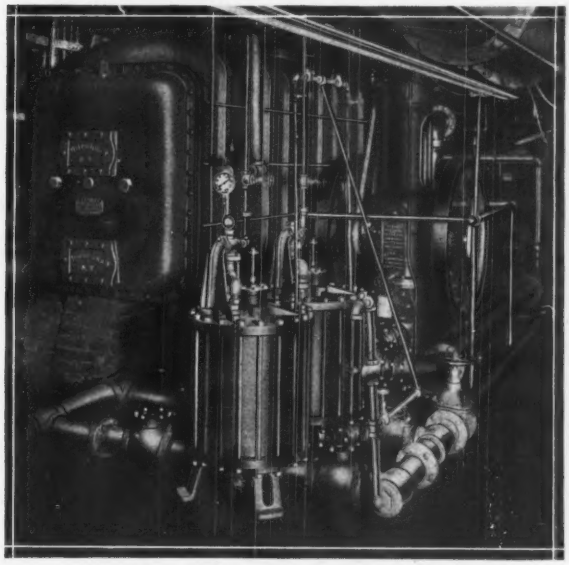
In Fig. 4, diaphragm tube 8 is shown in the pressure chamber of the casing 11 directly connected to one end of the rotating shaft passing through the patented pressure seal, and having its other end directly connected to the recording pen arm 9.

This diagram also shows a set of interlocking valves 17, 18 and 23, which constitute a device for adapting recording differential pressure gages to practical operating conditions. Cross-valve 22 is shown in an open position connecting the 2 pressure pipes. Valves 17 and 18 in the pressure pipes are shown closed. Both of these valves 17 and 18 can be opened, allowing the static pressure from either pipe to be applied simultaneously to the inside and the outside of the pressure tube of the actuating mechanism. The interlocking member 21 can then be turned through an angle of 90 deg., thus making it possible to close valve 22, which completes the connections so that the instrument will record the difference of 2 pressures.

Figure 5 shows a patented safety device consisting of a U tube 30 partly filled with a suitable liquid such as mercury or water, this tube having enlargements 33 and 34, each with sufficient volume to accommodate the quantity of liquid contained in the U tube. The length of the U tube varies with the range of the gage so that the greatest possible head of the liquid contained in the U tube corresponds with the total range of differential pressure that the gage is designed to record. Should the full static pressure be admitted by accident to either side of the differential gage, the liquid contained in the safety U tube would instantly be forced up into one of the enlargements, thus allowing the static pressure to be applied simultaneously to both inside and outside of the pressure tube and protecting it from being destroyed.

NEW USE FOR VACUUM TRAPS

DURING a 6-months' tryout in the power plant of the Jacob Ruppert Brewery, New York, 2 Lytton vacuum and lifting traps have proved conclusively their exceptional value for handling condensation from surface condensers. In this plant considerable difficulty had been experienced in using



INSTALLATION OF LYTTON PERFECT VACUUM AND LIFTING TRAPS

the condensation as delivered from the condenser by a wet vacuum pump into the distilled-water ice plant, owing to the emulsion of air and water which made foggy ice.

Part of the power plant of the brewery is run condensing, the condensing outfit consisting of 2 1200-hp. Wheeler condensers, each equipped with a single Edwards air pump and an efficient oil separator on the inlet. The condensers are located only 30 in. above the basement floor and this arrangement presented further difficulties in the handling of the condensation.

To solve this problem without interfering with the continuous operation of the plant, the wet vacuum pump was converted into a dry vacuum pump, at slight expense, and is used to remove the air and noncondensible gases from the condenser. From the bottom of the condenser a connection was made to 2 special vacuum traps, designed and built by the Lytton Mfg. Corporation, which removed the condensation from the condenser and delivered it to the ice plant.

Air and other noncondensible gases being removed by the vacuum pump, the condensation collects quietly and drains to the trap, free of air, and is delivered to the ice making apparatus without the necessity of further treatment.

After the traps were properly installed, the vacuum in the condenser was maintained at 28½ in. The distance between the highest point to which the water rises in the trap and the bottom of the condenser is 6 in., and with this low head 2 traps are able to handle a maximum amount of 400 lb. a minute from a vacuum of 28½ in., the inlet and outlet pipes each being 4 in. There is no heating of the condensation or reevaporation, since the time it takes to equalize from 5 lb. pressure to a 28-in. vacuum, when the trap is through discharging, is only 3 sec.

In construction the trap consists of a vertical cylinder with inlet and outlet at the bottom and one of the regular Lytton steam and vent valves located on top and outside where it is convenient and accessible. On the inside of the cylinder is a floating piston of an efficient design, which operates the steam valve. With the exception of the 2 check valves, there is only 1 valve in the apparatus and it is so automatic that to operate the trap requires only the opening of the steam valve and it will regulate itself.

From the results obtained in this plant, it is evident that the Lytton vacuum trap has solved a problem which has long perplexed a great many operating engineers. Located on the drips of the steam chambers of multiple effects on account of their simplicity and automatic operation, these traps overcome many of the difficulties encountered with sweet water pumps. The space required is small and no special foundation is needed. Such traps can also be used for handling condensation from low-pressure systems and elevating it to tanks or hot wells.

Having been so successful in solving the above problem and in other experimental work carried on with these traps, the Lytton Manufacturing Corporation of New York has just placed on the market a complete line of Lytton Vacuum & Lifting traps in sizes from 1 to 6 in. inlet and outlet, with capacities from ½ to 30 tons of condensation an hour.

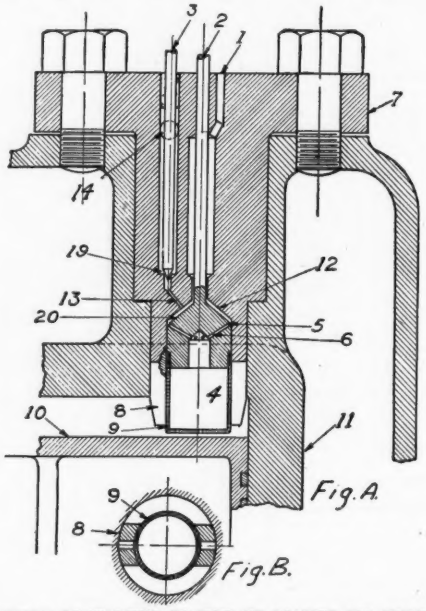
ST. MARY'S OIL ENGINES

ADVANCE in the price of gasoline has made it desirable to use heavy oils for power, even in small units, and the St. Marys Machine Co., St. Marys, Ohio, has brought out an engine, in sizes from 1½ to 500-hp., which has some unique features.

A section of the valves in the cylinder head is shown herewith; 4 is a combined primary cylinder and valve, to which air is brought through the vent 1 and the small ports 5 and 6. The fuel oil enters through the needle valve 3 and the port 19, drawn by the suction of the engine. Outlet from the primary cylinder 4 is through ports 9, in 2 ways: Either by the motion of the valve endwise, as shown in Fig. A, from the valve stem tube being forced downward by the intake rocker arm, or by the revolving of the valve, as shown in Fig. B, so that the port is opened past the timing lugs 8.

The device acts as a separating apparatus for the light and heavy hydrocarbons. The lighter part of the fuel ignites easily at a temperature easily reached by the heat of compression. The heavier parts of the oil are then drawn into the cylinder and burn as they enter.

Starting with the piston just beginning the suction stroke, the intake valve (not shown in the illustration) is opened by a rocker arm, and at the proper point, valve 4 is opened to the position shown in Fig. A, throwing port 9 below the end of the timing lug 8. The reduced pressure in the cylinder from suction draws air into the primary cylinder 4 through the air vent 1 and ports 6, and also oil is sucked into this



SECTION OF VALVES OF THE ST. MARYS OIL ENGINE

cylinder through the ports 6, past the fuel valve 19.

On the compression stroke, the valve 4 seats at 12, cutting off all connection with air and oil supply, and also closing the ports 9.

Sufficient compression works past the fit of valve 4 to raise the pressure in that primary cylinder and cause ignition early in the stroke. This primary ignition inside the cylinder 4 raises the pressure there and thus forces the heavy oil from the bottom of the cylinder 4 out through ports 9, which are rotated, as shown in Fig. B, into the main cylinder, where it burns, producing heated gases which expand. The ordinary expansion and exhaust strokes complete the cycle.

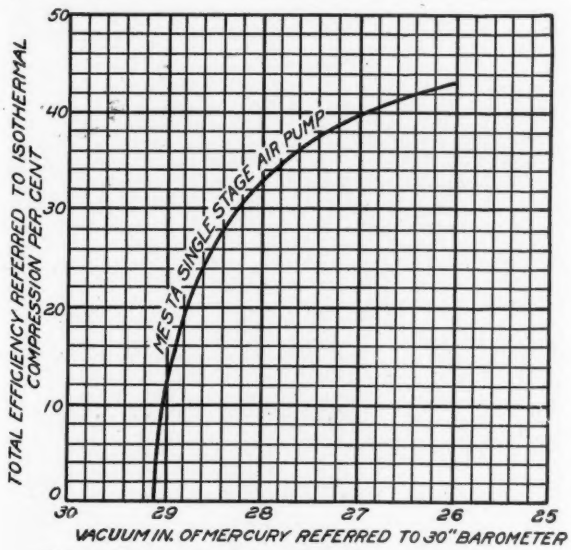
This process is repeated for each cycle, and it will be seen that high-pressure pumps and air compressors are not needed. Fuel flows to the engine by gravity, and ignition is accomplished without the use of a spark. The builders state that the engine starts on the fuel without preheating, and can use kerosene, crude oil and grades of heavy oil without producing carbon deposits in the cylinder; also that any oil which will flow when reasonably warm can be used in the engine. The fuel consumption ranges from 0.7 of a pint per horsepower-hour for large engines up to 0.8 of a point for small engines.

EFFICIENCY OF RECIPROCATING CONDENSER AIR PUMPS

IN a new design of reciprocating air pump, placed on the market by the Mesta Machine Co., of Pittsburgh, the valves are automatic of the multiported plate type, having no flash ports and no large clearance spaces. These valves open and close at the right time, independent of any adjustment.

Tests have been made on this pump by Prof. Trinks, of the Carnegie Institute of Technology, the flow of air being measured by a nozzle, and the steam used by the pump being condensed and measured in barrels.

In figuring the results of these tests, the efficiency was taken at the ratio of the ideal work required for



VARIATION OF AIR PUMP EFFICIENCY WITH VACUUM CARRIED

isothermal compression divided by the actual work for compressing the air, including all the friction work of the engine. The pump was used only for removing the air from the condenser, and not for removing the condensation. In the figure herewith is shown a curve between the efficiency calculated as already explained, and the inches of vacuum produced. The curve shows a high efficiency for vacuums of 28.5 in. and less, and although the single-stage pump becomes useless for higher vacuum than 29.1 in., a compound air pump is now being built which will be tested and the results made public.

USE OF TITANIUM IN MANUFACTURE OF STEEL RAILS

THE beneficial effect of titanium is not that of an alloying element proper, but the titanium acts simply as a purifier. It is a powerful deoxidizer and removes part, if not all, of the nitrides as well. It prevents brittleness, hence the carbon content of the rail may be materially increased and should be increased if the full benefit of the titanium treatment be desired. The extra cost of the titanium is only about $2 per gross ton of finished rails.

The following is a test of open-hearth 85-lb. rail made recently by the Lackawanna Steel Co., for the Delaware & Hudson Co. This steel was treated with 0.15 per cent titanium alloy and tested by the National Tube Co. The elastic limit was 100,800 lb. per square inch, the ultimate strength 147,200 lb. per square inch, the elongation 12.50 per cent, the reduction 16.29 per cent. The analysis was 0.86 C, 4.132 Si, 0.022 P, 0.032 S, 0.88 Mn, 0.065 Ti.—Mining and Engineering World.

BOOK REVIEW

THE D'ESTE STEAM ENGINEERS' MANUAL with Electrical Appendix by Charles Penrose; 356 pages, 240 illustrations, with plates, tables and formulas. Full leather binding, with gilt edges, 5 by 7 in.; Boston, 1913; price $2.00.

In this book the mathematics needed by the steam engineer are given briefly, with full examples as to the use of the methods described, and showing the processes of arithmetic, algebra, trigonometry and the use of logarithms.

The properties of steam are explained, giving a short steam table, and showing how to use it in figuring out problems in regard to steam machinery. Directions for the care of steam boilers, making evaporative tests, explanation of the injector, the steam pump, and of transmitting machinery are given, a discussion of riveted joints and the strength of boiler shells, and how to compute the strength of boiler stays. A special section on the steam engine indicator, how to use it and what it shows, has been prepared by W. R. Van Nortwick.

The special appendix on electricity and electro-machinery, begins with a summation of trigonometric and calculus formulas, presupposing a knowledge of these subjects on the part of the reader. The electrical units are explained, and the relations of the alternating-current circuit. Methods of making measurements for resistance and power are given, with a very complete description of the different instruments used for such work.

Following is a section on dynamo-electric machinery, explaining direct-current generators and motors, and the method of connecting up for different types and purposes; then alternating-current generators, showing the different methods of connection, also the different kinds of alternating-current motors, their properties and how they are operated.

Transformers and their connections are given full treatment, and the subject of electrical measurement of temperature, both by thermometers and pyrometers, is given with special completeness.

As the engineer has much to do with the details of illumination, particular attention has been paid to the matter of photometry, the apparatus used in making measurements, and the methods to be employed to get correct results; also the proper amount of illumination to be provided for different conditions.

A feature of the book is the organization charts, showing the equipment of both steam and electrical plants, the different pieces of apparatus and instruments employed, and how they are related to each other; and in connection with these is given a synopsis of the equipment of an alternating-current generating station for both high and low pressure, showing exactly what is required in each part of the system and what part each piece of apparatus plays in the operation of the entire plant.

Detailed illustrations are also given of the different kinds of apparatus which may be employed and the way that these act. Sections devoted to the illustration of types of apparatus, dynamo electric machinery, typical

generating stations, both steam and hydro-electric, and generating station equipment, make clear the commercial side of the work.

The book can be secured by writing direct to the Julian d'Este Company, 24 Canal St., Boston, Mass., and enclosing the price, $2.00, which is a very moderate charge for a book of such quality.

"THE STEAM CONSUMPTION of Locomotive Engines from the Indicator Diagrams," by J. Paul Clayton, has been issued as Bulletin No. 65 of the Engineering Experiment Station of the University of Illinois.

This bulletin develops and illustrates the application of the logarithmic diagram to locomotive engines. It is shown that the steam consumption of locomotive engines can be determined from the indicator diagrams alone to within 4 per cent of the actual consumption as measured in test plans.

Copies of Bulletin No. 65 may be obtained upon application to W. F. M. Goss, Director of the Engineering Experiment Station, University of Illinois, Urbana, Ill.

RESUSCITATION by Dr. Chas. A. Lauffer, Medical Director, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., includes a reprint of a paper on this subject delivered by the author before the Philadelphia Section of the National Electric Light Association. The author, after explaining a number of successful results which have been obtained from employing resuscitation methods on men who were supposedly dead, gives a clear description of the mechanism of respiration, illustrating same by a number of views of the various parts of the anatomy.

The Prone Pressure or Schafer method of resuscitation which has been adopted by the National Electric Light Association, and a number of other engineering societies, is described in detail.

This book brings out in a clear, concise manner the necessity of people in general being versed in the principles of resuscitation, and clearly shows how they can be learned so as to prove of valuable assistance to persons in the ordinary walks of life.

CATALOG NOTES

YARNALL-WARING CO., of Philadelphia, has issued a new circular descriptive of the Simplex seatless blowoff valve.

FROM ARMSTRONG CORK CO., Pittsburgh, Pa., we have recently received a folder regarding Nonpareil high-pressure covering.

AUTOMOBILE NUMBER of "The Bearing" has recently been received from Albany Lubricating Co., 708-710 Washington St., New York.

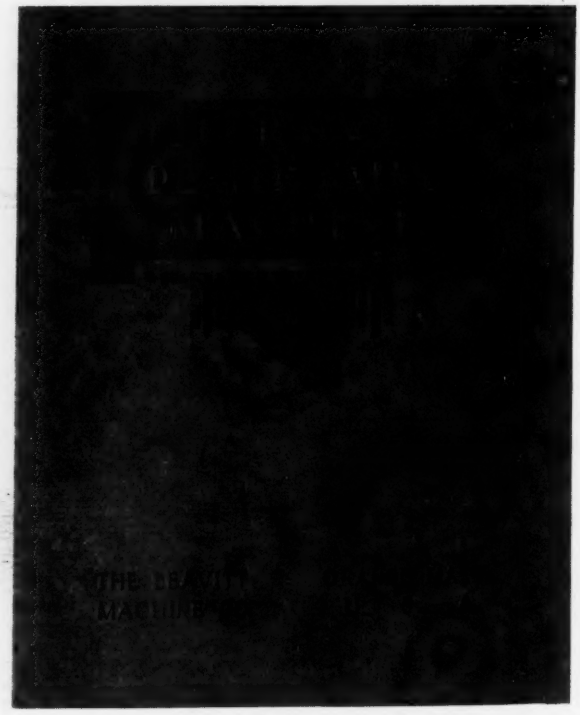
SMOOTH-ON MFG. CO., Jersey City, N. J., has issued a new circular—Extracts from Smooth-On Instruction Book No. 12—and will be pleased to send copies to those desiring them.

OIL AND GREASE cups for engine and machinery bearings are illustrated and price lists are given in a pamphlet recently issued by the D. T. Williams Valve Co., of Cincinnati, Ohio.

ROCKFORD'S SUCCESSFUL UNIT WELL is the title of a booklet describing an experimental water substation and deep well in Rockford, Ill. The booklet has been prepared as an aid in answering inquiries made by waterworks officials relative to the installation, which includes many new features.

"WHEREVER YOU GO the world over, a package of Cling-Surface sits beside the belts," is the claim made by the Cling-Surface Co., Buffalo, N. Y., and used as the apt title of a 24-page booklet describing and illustrating installations of Cling-Surface treated belts in Germany, England, Scotland, Ireland, Norway, Sweden, France, Spain, Switzerland, Belgium and many more foreign countries. It is a convincing little booklet and will be sent free on request to every user of belts.

DEXTER PUMP VALVE reseating machine for reseating all flat and taper seated valves, ¼ to 12 in., without disconnecting the valve from the pipe, is described in a 28-page illustrated catalog recently received. A list is



given of naval stations, battleships, etc., in the United States Navy using the machines, which are manufactured by the Leavitt Machine Co., of Orange, Mass.

A FAN OR BLOWER of novel design is described in a leaflet entitled "Green's Conical Flow Fan," issued by the Green Fuel Economizer Co., of Matteawan, N. Y. This differs from either centrifugal or axial flow fans in that the air enters and passes through the fan wheel and through the diffuser or stationary housing obliquely to the shaft, so that the lines of flow form substantially a cone co-axial with the shaft. It is claimed that this construction results in large air-handling capacity with a given diameter of wheel, permits high speeds and is efficient in producing pressure. In other words, the volumetric capacity and the ability to run at high speeds possessed by the ordinary axial-flow or disk fan are combined with the power to produce moderately high pressures, such as are required in heating and ventilating work, mechanical draft, etc. The object of attaining higher speeds is to permit of connecting the fan directly to standard-speed electric motors and steam turbines, thereby eliminating belts, gears, or chains. The leaflet, which gives a table of sizes, capacities, pressures, speeds and motor horsepowers, should prove of particular interest to architects and others requiring fans to be installed in limited space.

THE OHIO BRASS CO., Mansfield, O., has recently issued a circular relating to Ohio globe, angle, check, gate, lock-shield and radiator valves.

FROM MARK MFG. CO., of Chicago, we have received an illustrated pamphlet on the Mark cold drawn steel union.

DIXON CASCADE PUMP CO., of Newark, N. J., has recently issued a catalog describing and illustrating its pumps.

FOSTER GRATES, valves, boiler feeders, etc., are described and illustrated in a catalog from F. W. Foster & Sons Co., Boston, Mass.

BULLETIN B-13 from Affiliated Manufacturers, Caswell Bldg., Milwaukee, on Ferroform piston molding machines will be of interest to gas engine manufacturers.

NONPAREIL COVERING for steam lines and boilers is described and some methods of testing are suggested in a folder from Armstrong Cork Co., Insulation Dept., Pittsburgh, Pa.

CHAS. A. SCHIEREN CO., 30-38 Ferry St., New York, has recently issued its Spanish catalog, copies of which will be furnished to intending purchasers in Spanish America.

BLAKE-KNOWLES single direct-acting pumps in various types for many kinds of service are described and illustrated in an 84-page catalog recently issued by the Blake & Knowles Steam Pump Works, 115 Broadway, New York City.

THE OTTO CYCLE is devoted to a discussion of internal combustion engines in general, giving the history of their development, and the Otto Gas Engine Works product in particular. Copies may be obtained by addressing the company at 33 Walnut St., Philadelphia.

WILLIAM TELL, who literally shot into fame, is the theme of a folder in the Makers of Unions series issued by Jefferson Union Co., Lexington, Mass. Jefferson unions are also discussed from the standpoint of hitting the mark as to meeting pipe requirements.

THE GREEN FUEL ECONOMIZER Co., Matteawan, N. Y., has issued a pamphlet containing reprints on "Heating and Ventilating Large Buildings," from The Iron Age, and "Heat Transmission through Building Walls of Corrugated Iron," from The Engineering News.

NEW PAPERS published by the Bureau of Mines, Department of the Interior, are as follows:—Technical Paper 37, on "The Use of Heavy Oils in Internal Combustion Engines," by I. C. Allen, 36 pages; Technical Paper 49, "The Flash Point of Oils and its Determination," 15 pages. Copies can be had by applying to the Director of the Bureau of Mines, Washington, D. C.

"WHEELER CENTRIFUGAL PUMPS" is the title of Bulletin 108 recently published by the Wheeler Condenser & Eng. Co. This bulletin considers the general construction of Wheeler Centrifugal Pumps, illustrating a cross section of a typical pump and the general design of pump casing and impeller. Copies will be sent to engineers on request.

A. S. CAMERON STEAM PUMP WORKS has just issued a bulletin on its new line of double suction volute centrifugal pumps. Besides the various illustrations and descriptions, there is much detailed information about the merits of this new pump, which is modern in design, with an enclosed impeller and a horizontally split casing, allowing quick and ready access to all interior parts. This bulletin also contains an efficiency chart, tables of figures on pressures, friction, etc., that will prove of value to engineers.

THE GENERAL ELECTRIC CO. has recently issued Bulletin No. A4086, devoted to the subject of circuit breakers for railway service, Type MR. It supersedes the company's previous bulletin on this subject.

Bulletin A4070, from the same company, illustrates and describes its electrically operated remote control switch, Type R, Form C2, which is adapted for use wherever control from a central point is desired. It is made for both alternating and direct current.

AS A COMPANION BOOK to "Catechism on Direct Current Apparatus," Fairbanks, Morse & Co., of Chicago, has recently issued a Catechism on Alternating Current Apparatus. It is a booklet dealing with the construction and application of generators, motors and auxiliary equipment in which the writer has succeeded in giving in a condensed question and answer form a great amount of practical information, including a short description of how alternating current is produced, Advantages of Alternating Current, Advantages of Direct Current, Choice of A. C. or D. C., Electrical Characteristics that must be considered in comparing alternators, Advantages and limitations of Synchronous Motors.

Copies will be sent to interested parties on request to the company.

INGERSOLL-RAND PRODUCTS is the title of a 140-page catalog just issued by the Ingersoll-Rand Co., 11 Broadway, New York City. This booklet is complete, not only in illustrating the entire line of the company's production, but the dimension and the capacity tables shown with each type of machine are of invaluable assistance to an intending purchaser in selecting machines of a specified type and size to meet certain requirements. The book tells of the many uses of compressed air in the different fields and practically 20 pages are devoted exclusively to tables of horsepower required to compress air from atmospheric pressure to various gage pressures, efficiency tables of air compression at different altitudes, compressed air transmission tables, drill capacity tables, indicator charts, etc. A request to the New York address or any of the branch offices will bring a copy to any engineer.

DE LAVAL VELOCITY-STAGED TURBINE described in a 108-page book just issued by the De-Laval Steam Turbine Co., Trenton, N. J., has not only a single pressure stage, but multiple velocity stages, that is, the steam is expanded completely from initial pressure to terminal pressure in a single set of nozzles, after which it impinges upon a first row of moving buckets and is then deflected to a row of stationary vanes from which it is again directed upon a second row of moving buckets. A second row of stationary guide vanes and a third row of moving buckets are added in some cases. This turbine is built in all sizes from 1 to 600 hp. and is adapted for driving centrifugal pumps and blowers, small generators, centrifugal air compressors and similar machines.

Copies of this book will be sent free to owners, managers, designers, operators, and others directly interested in the development of steam power.

AMERICAN ROLLER BEARING CO., of Pittsburgh, Pa., has recently issued a folder showing the operation and advantages of American roller bearings.

READING GAS POWER, a Word on Needless Industrial Waste, is the title of a pamphlet relating to the Illmer gas engine, the Reading gas producer and the Reading gas scrubber, manufactured by Readng Iron Co., Reading, Pa.

THE GENERAL ELECTRIC CO. has just issued Bulletin No. A4123, which is a 44-page bulletin, attractively covered, superseding a previous bulletin on this subject, and describing the company's automatic voltage regulators for the regulation of generator voltage. These regulators are made for use with both alternating and direct current.

Bulletin No. A4121, from the same company, is a revision of the company's bulletin on direct current motors of the commutating pole design.

TRADE NOTES

AMERICAN ENGINE CO., of Bound Brook, N. J., has recently received an order from the Minnesota & Ontario Power Co., of Minneapolis, Minn., for 2 500-hp. 4-cylinder variable speed paper mill engines, to be installed in the new mill of the above company, located on the Canadian side of the Rainy River at International Falls. These engines are of the type described in May 1 issue of Practical Engineer.

B. S. REDERER has opened an office at 518 Park Building, Pittsburgh, Pa., for the sale of power plant equipment. The accounts represented by him are as follows:

The Brownell Co., Dayton, Ohio, boilers, engines, feed-water heaters and steel tanks; W. K. Mitchell & Co., Inc., Philadelphia, Pa., power plant piping, erected or material only; Canton Grate Co., Canton, Ohio, Canton rocking and dumping grates and kiln grates; Burt Manufacturing Co., Akron, Ohio, exhaust heads and oil filters, etc.

THE UTILIZATION OF gas engines driven by city gas, is a comparatively recent branch of power development, and the United Gas Improvement Co., of Philadelphia, is doing extensive work in showing the saving to be secured in this way. A recent pamphlet, entitled "A Thousand Uses for Gas," shows some of the results that may be accomplished by using city gas instead of gasoline as fuel in small plants, gives a list of gas engines which the company is prepared to furnish, and also the engineering staff that it maintains to look after its gas engine department.

THE AMERICAN ENGINEERING COMPANY, Philadelphia, Pa., builders of the Taylor stoker, recently booked orders from the following concerns: The Katahdin Pulp and Paper Co., Lincoln, Maine; The Rochester Railway and Light Co., Rochester, N. Y.; The Firestone Tire and Rubber Co., Akron, Ohio; large order from Dan River Cotton Mills, Danville, Va.; The Fleischmann Co., Peekskill, New York; The American Bridge Co., Pencoyd, Penna.; The Hood Rubber Company, Watertown, Mass.; Youngstown Sheet and Tube Co., Youngstown, Ohio; DeLaval Separator Co., Poughkeepsie, N. Y.; Narragansett Brewing Company, Providence, R. I.; Lake Shore and Michigan Southern Railway Co., Air Line Junction, Ohio; G. W. Blabon Co., Philadelphia, Pa.; Ohio State University, Columbus, Ohio; Fitchburg Gas and Electric Co., Fitchburg, Mass.; Narragansett Electric Light Co., Providence, R. I., large repeat order.

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Eighth page, one year, each insertion, $12.00.
Front cover, $150.00 per issue.

Other specified positions, regular rate plus 10 to 50 per cent.

Stippled plates used but no heavy black and white plates.

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Classified Rates

Per line, 30 cents each insertion.

Advertisements in this section are inserted under regular headings.

No display type allowed, but the first three words may be set in capital letters.

About nine words make a line. Minimum space sold, two lines.

Under classification "Position Wanted," advertisements not exceeding four lines will be inserted once for subscribers free of charge.

All copy should be received at Chicago office 18 days before date of publication.

Circulation of this issue, 22,500

Technical Publishing Co.
537 S. Dearborn Street
Chicago

Positions Wanted

POSITION WANTED—Watch Engineer in medium sized hydro-electric and reciprocating engine plant, desires position as chief in a similar plant. Good references. Liberal education and experience. Address Emerson B. Tifft, Box 606, Broad Brook, Conn. 7-15-2

POSITION WANTED—By first-class Steam Engineer. A. and D. current. Can give results and best of reference. Sober and steady, 14 yrs.' experience. Address Box 309, Practical Engineer, Chicago, Ill. 7-1-3

POSITION WANTED—As an Assistant Engineer or an oiler. In or near Chicago. I have 6 yrs. practical experience in handling pumps or boilers; also 3 yrs. experience in steam fitting and all kind of repair work. At present I am in a 500-H. P. plant as an assistant. I have a city water tender license. I am married, age 25 yrs. Would prefer a place where I could advance myself. Address Joseph P. Sepp, 3418 Le Moyne St., Chicago, Phone, Belmont 5378. 7-1-3

POSITION WANTED—Young married man with technical education. Mechanical draftsman. Practical experience with oil engines and ice machinery. At present engineer in small ice plant. Desire position after November 1st. Best of references. Permanent position wanted with offer of promotion for the man who makes good. J. B. Walker, Savannah, Tenn. 7-1-3

POSITION WANTED—As Chief Engineer on or about September 15, 1913. Age 40 yrs., with 25 yrs. Practical and Theoretical training, 5 yrs. with present employer. First Class New York License. Own Indicator and a good set of Tools. Address Box 311, Practical Engineer. 8-1-3

POSITION WANTED—As Electrical Engineer; at present in charge of large electrical plant in New York. 12 years technical and practical experience. Strictly sober and industrious. Address William MacInally, Pleasantville, N. Y. 7-1-3

POSITION WANTED—As Engineer in small plant, or assistant in a large plant, by man of 28 yrs. No bad habits, 3 yrs. machinist experience; understands A. & D. current; holds local engineer's license. C. H. Freeman, 57 North St., Elgin, Ill. 7-1-2

Wanted

MANUFACTURERS REPRESENTATIVE, favorably known and of wide experience in modern engineering, wishes to handle power-plant equipment, engines, boilers, stokers, etc., in Pittsburgh district. Daniel Ashworth, M. E., 1225 Fulton Bldg., Pittsburgh, Penn. 7-15-4

WANTED EVERY ENGINEER to have our pamphlet for setting valves on Corliss Engines, simple and compound, with one or two eccentrics. Sent free. Lindstrom's Machine Works, 200 South Third St., Allentown, Pa. tf.

WANTED—ALL STEAM USERS to have clean boilers without using compounds or chemicals in any form. Write "Otis," No. 317 Norfolk Ave., Buffalo, N. Y. tf.

IF YOU ARE a night engineer, spend a few hours each day taking subscriptions for Practical Engineer. You will be paid well. Write Subscription Dept. They will start you in at once.

Help Wanted

WANTED—A thorough competent first class engineer, for Boston position, must be a member of the Engineers' Union, capable of making repairs, and familiar with automobile construction. A knowledge of refrigeration desirable but not absolutely necessary. Wages $35 per week, six days, eight hours per day. Address giving full particulars as to qualifications, references, etc. Address Box 313, Practical Engineer. 8-1-1

WANTED—An additional subscription solicitor wanted to cover towns in the state of Washington. Excellent chance to earn extra money. Write to Subscription Department. tf.

WANTED—Man experienced in testing steam and electrical machinery. Steady position. Give references and experience. Address Box 312, Practical Engineer. 8-1-1

Patents and Patent Attorneys

PATENTS SECURED—Send sketch or model for search. Book containing over 200 mechanical movements, advice and search free. W. N. Roach, Jr., 515 Metzerott Building, Washington, D. C. 5-15-7

PATENTS THAT PROTECT AND PAY. Advice and books free. Highest references. Best results. Promptness assured. Send sketch or model for free search. Watson E. Coleman, Patent Lawyer, 624 F Street, Washington, D. C. tf.

PATENTS—H. W. T. Jenner, Patent Attorney and Mechanical Expert, 606 F St., Washington, D. C. Established, 1883. I make a free examination and report if a patent can be had and the exact cost. Send for full information. tf.

PATENTS—C. L. Parker, Attorney-at-Law and Solicitor of Patents. Patents secured promptly and with special regard to the legal protection of the invention. Handbook for inventors sent upon request. 186 McGill Building, Washington, D. C. tf.

THE PATENTOME is interesting and instructive. A liberal education in patents and how to get them. Free on request. Established 1865. Anderson and Son, Patent Solicitors, 710 G St., Washington, D. C. 8-1-2

PATENTS SECURED. Legal protection our specialty. Booklet free. Harry Patton Co. Suite 330, McGill Building, Washington, D. C. tf.

PATENTABLE IDEAS WANTED—Send for 3 free books. R. B. Owens, 28 Owens Bldg., Washington, D. C.

Educational and Instruction

ELECTRICITY—JUST WHAT YOU HAVE been looking for. Our Modern Blue Print Chart Method of Electrical Wiring Diagrams. Thoroughly explained so that you can easily understand them. All kinds of Bell Wiring, Annunciators, Telephones, House Wiring, Conduit, Theatre, Isolated Plants, Dynamos, Transformers, Arc Lights, Special Treatise on Motor Wiring. Write now for information. Electrical Wiring Diagram Co., Box F. 173, Altoona, Pa. 6-1-6

ENGINEERS' POCKET MANUAL. 175 pages, edited by University of Tennessee, will be mailed every subscriber sending in one new subscription to Practical Engineer. Gild edges, bound in leather.

Miscellaneous

IF YOU ARE an operating engineer, we know the Fetta Hot Process Water Purifier will interest you. We would be glad to have your request for further information. Address the Fetta Water Softener Co., Richmond, Ind. tf.

ENGINEERS—DO YOU WANT to utilize your exhaust steam for heating or dying purposes, without back pressure on your engine? If so, address Monash-Younker Co., 1413 W. Jackson Blvd., Chicago, Ill. tf.

MAKE MONEY on the side. Here's your chance to work out some money for yourself. Get subscriptions for Practical Engineer. It pays well. Just drop a line to the Subscription Dept. They will tell you. tf.

Sparks From The Advertising Pages

On State, near Van Buren Street, Chicago, stands a bent old man, bearing a tray containing shoe strings. For many years,—six week days and Sunday, too,—his appeal, "shoestrings 5c a pair," has been heard by the people passing there.

Across the street is a colossal, many-storied institution—a store so well organized that it can supply the decorations and furnishings for your house or sell you live minnows and frogs for bait on your fishing trip. In their notion department—on a sunken-top counter—you will find the same grade of shoestrings marked "5c per dozen."

The tray merchant, in his years of business, has been able to reach only the people passing his stand. At the very best, his profits at 5c per pair would hardly be more than a living wage.

The Department store, with its trained advertising staff, uses hundreds of square feet of show windows, mails out and distributes millions of catalogs, booklets and circulars, and fills columns of the daily newspapers with its advertisements. All day long a stream of buying humanity pours in at its doors, attracted by its advertisement of the day or through the *accumulated power* of past advertising. Their yearly purchases run into the millions.

This store can sell on a lower margin of profit than the tray merchant, because of its immense volume of business. Its weekly sales of shoestrings, alone, will probably exceed the yearly sales of the forlorn competitor across the street.

Who pays the cost of advertising? Not the Customer. Not the Advertiser. It is *absorbed* by the *economy* created by an *increased volume* of sales.

Advertising speaks to *thousands* instead of *units*. It makes every day in the week a *selling day*. It builds *distribution*.

The machinery manufacturer, by *Advertising*, is enabled to sell his product quicker,—oftentimes in advance of its manufacture. He wastes no *cost of facilities*, such as idle machines, operatives and floor space, due to lack of market. He turns over his capital more often—can do business on a smaller investment.

For example, the manufacturer with $100,000 capital, who by making *quick sales* is able to do a $600,000 business, can afford to sell on a lower margin of profit and, at the same time, obtain a larger return on his investment than one who with the same capital does only a $200,000 business.

Advertising is a wonderful *Agent of Economy*.

The biggest Merchant Prince this country has ever known, wanted to keep free from printer's ink. He was forced to give up this position of *false dignity* and to utilize advertising in maintaining his small margin of profit.

The Standard Oil Company—pointed out as the most efficient organization for production and distribution—advertise to *stimulate* the human desire for its products.

So, dear sir, when you read the advertisements of the manufacturers in the pages of Practical Engineer, you may rest assured that their *ultimate cost* will not be borne by either you or the manufacturer.

Advertising reduces cost of production by increasing output without a proportionate increase of cost for labor and equipment.